ELECTRICAL REVIEW

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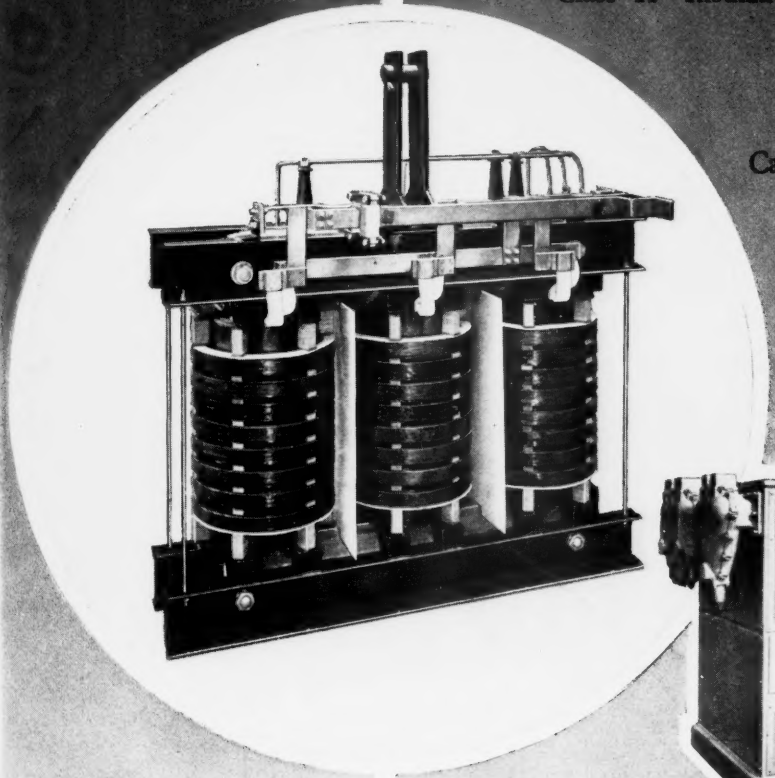

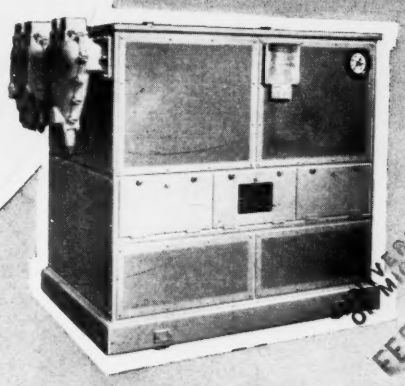

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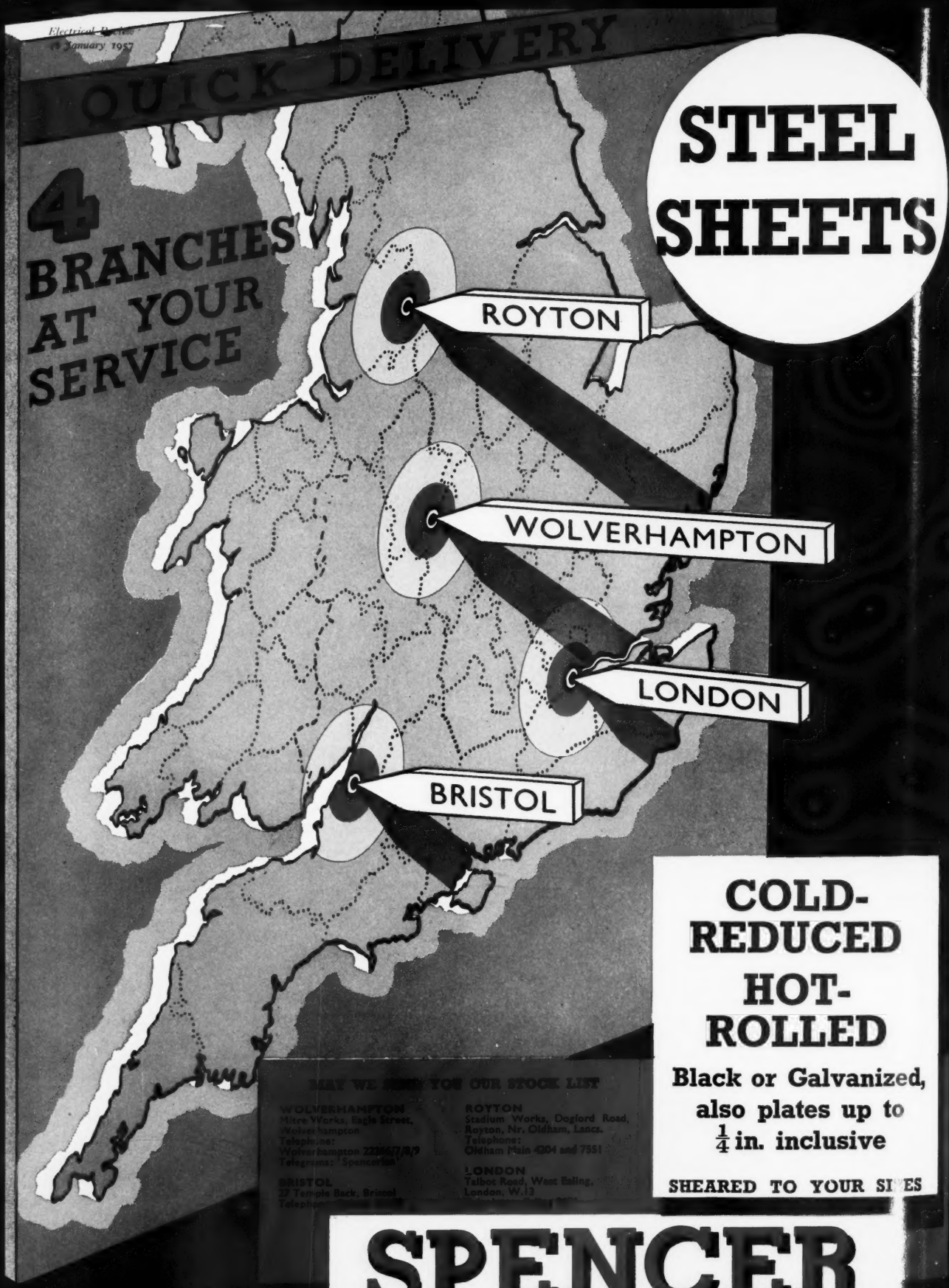

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18 JANUARY
1957

ELECTRICAL REVIEW

Managing Editor: HUGH S. POCOCK, M.I.E.E. *General Editor:* J. H. COSENS *Technical Editor:* P. W. TUCKER, M.I.E.E.

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ELECTRICAL REVIEW

18 January 1957 Vol. 160 No. 3 Established 1872

Electricity in Horticulture

As with so many uses of electricity, progress in its application to horticulture during the past decade has not only greatly exceeded general expectations but has also warranted some optimism for the future. The most notable change has been the raising of the status of electro-horticulture from that of a hobby, more or less, of enthusiastic amateur gardeners to a position of commercial significance. In the investigations that have led to the advance the Electrical Research Association has played a predominant part.

From the paper given this week by Messrs. C. A. Cameron Brown and A. W. Gray before the Institution of Electrical Engineers (and reported on page 115) it is evident that to implement the findings of research by the Association and other bodies much more is called for than a knowledge of those electrical factors that secure a satisfactory installation. Such knowledge needs to extend, even more than in most industries, to extraneous techniques essential to obtaining the maximum benefit from electrification. Regarding installation, the authors' recommendation as to the maximum voltage desirable in soil warming is one to be heeded.

Adaptation of results of early experiments to modern commercial requirements has not been easy, especially in economic aspects, and some of the hopes based on incomplete data, as for soil warming, have not altogether fulfilled expectations. On the other hand the tentative results achieved have pointed the way to other and more profitable means for exploiting their fundamental merits. Although the advantages of direct electric heating do not at present appear to justify the higher operating costs entailed, the efficient working of solid-fuel and oil plant depends substantially on the functioning of electrical auxiliary components which amount in the aggregate to an appreciable figure. In any event the service to the consumer of relatively small-current-consuming devices count in cultivating good-will.

The case for electric heating is considerably improved by the facilities it offers for automatic close regulation of temperature since the waste of energy through permitting rises of a very few degrees above those necessary, or indeed desirable, is much greater than seems to be commonly recognised. There is still wide scope for study of the effects of electric light on plant growth and of the ways in which it may be employed to extend the daily period during which illumination can be profitably employed. Bulk statistics of the potential amount of electricity likely to be used in horticulture do not appear to be available, but figures concerning some individual installations mentioned in the paper indicate that from this aspect alone the load (much of it off-peak) is worth a sustained effort on the part of the Area Boards to encourage and secure.

COPPER PRICES

Daily fluctuations in the price of copper present difficulties to users in the costing of their products and the attempt of the Rhodesian Selection Trust to stabilise the price over a reasonable period is commendable. The arrangement was, in fact, made after representations by the British Non-ferrous Metals Association. Unfortunately the production of the R.S.T. group forms only a small proportion (about 7 per cent) of the world's output and the success of the system really depended on its adoption by the London Metal Exchange.

At a meeting of R.S.T. shareholders in London last week the chairman, Sir Ronald Prain, admitted the difficulties of a two-price system but emphasised the fact that outside this country the fixed-price system was general. He considered that it was not so much the level of prices but daily price changes which were the cause of concern to large sections of the copper fabricating and using industries. Sir Ronald's view was that the traditional methods of marketing copper had not received the re-appraisal which some thought necessary if the industry was to face up to its inherent possibilities of expansion on the one hand and, on the other, its dangers from competitive products.

DOMESTIC DISPLAY AT BRUSSELS

It is stressed by the B.E.A.M.A., which is organising the British electrical section at next year's Brussels Exhibition, that the collective exhibit will be "thematic." In other words it will not set out to publicise the products of individual manufacturers but will show visitors what the British electrical industry can do in every division—generation, distribution and application.

This idea is to be departed from in the separate domestic part of the display, particulars of which are given on page 96 of this issue. Here any manufacturer, for an additional charge, will be able to exhibit his appliances under his own name. As domestic equipment is the subject of very varied design and sells as much on its appearance as anything else the departure from the general scheme is no doubt justified.

PROTECTIVE DEVICES

It is noted from the national Press that the Aberdeen-London express rail crash which occurred at Welwyn Garden City last week brought to light the fact that although the stretch of line from King's Cross to Grantham has been equipped for automatic train control for some years the express itself was not fitted with receiving equipment.

We are somewhat puzzled at the apparent difference in attitude towards protective devices between the nationalised railways and the nationalised electricity supply industry as we are aware of the time, thought and money which the electricity supply industry very rightly devotes to devices for the protection of plant and people. If it is worth while to install protective gear and interlock systems in an ordinary distribution substation for the safety of plant and operators, surely the "Aberdonian," which travels at 70 m.p.h. with eleven coaches and some 300 passengers, should have been equipped with the necessary apparatus, particularly when a large section of the track on which it travels is already fitted with automatic control equipment.

MINISTER OF POWER

In the Government changes announced this week the only one of direct interest to the electrical industry is the appointment of Sir Percy Mills as Minister of Power (the term "Fuel" has been dropped from the title). Sir Percy (who has been given a peerage) is well known in the industry as chairman of Lancashire Dynamo Holdings, Ltd., and W. & T. Avery, Ltd. He is additionally a director of Babcock & Wilcox, Ltd., and Electric & Musical Industries, Ltd. He has a long record of public service and a wide industrial experience. Among his many activities, he was for about six years chairman of the National Research Development Corporation. One of Sir Percy's main endeavours in his new post will be to speed up the construction of nuclear power stations, in which direction he will have the active co-operation of a large section of the electrical industry.

"STIMULATING" EXPORTS

We report in this issue (page 112) an extraordinary case which has recently been before the American courts. It concerned agreements entered into by an American company with its former British and French associates, allotting each of them a "territory" which the others undertook not to encroach upon. Finding that this infringed the Sherman Act, the District Court of Ohio ordered the cancellation of the agreements. But it did not stop at that; it specified a series of positive steps which the American concern was to take in order to secure business in the territories of the others.

Although the Supreme Court confirmed the judgment, Government lawyers have put a construction on the decree which seems to take some of the sting out of it. Nevertheless there is still some doubt as to how far American courts can go to order American companies to compete in foreign markets.

EXPEDIENCY IN ENGINEERING

In his chairman's address to the I.E.E. Supply Section, Mr. P. J. Ryle referred to the influence of "expediency" rather than technical efficiency and economics in determining the choice and design of electrical apparatus. Transformers furnish good examples of this extraneous factor, not least in regard to the limitation of noise to values tolerable to the public. One way would be to reduce the flux density from, say, 13,500 lines/sq cm to 8,500, but this solution was shown at last year's C.I.G.R.E. (Brownsey, Glover and Harper) to increase the cost of manufacture by 25 to 30 per cent. Fortunately in this case alternative and less expensive methods are available which make departure from normal designs generally unnecessary. The view of the authors that external means of suppressing noise provides at present the most effective and economical method was supported by evidence contained in another C.I.G.R.E. paper (Tobin) regarding experience in other countries.

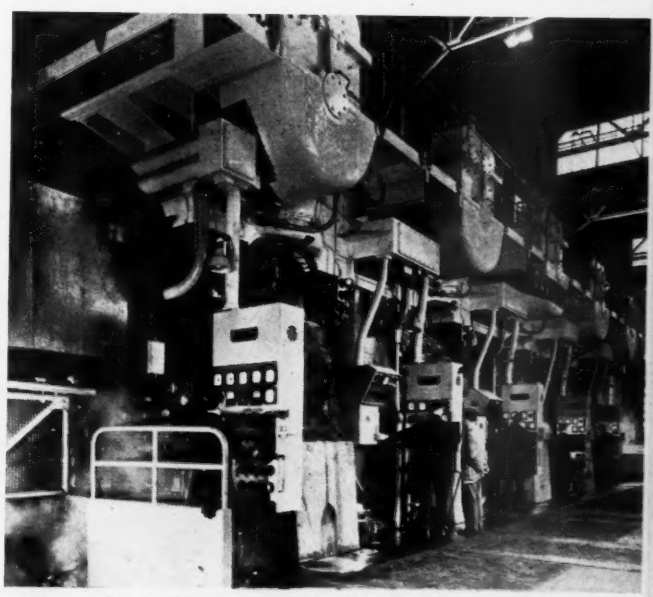
Rolling Mill Drives

NEW HIGH-SPEED TANDEM COLD MILL AT VELINDRE

AT the Velindre works of the Steel Company of Wales, Ltd., a new five-stand tandem cold reduction mill has recently been commissioned. The mill itself was supplied by Davy & United Engineering Co., Ltd., while the electrical equipment for the main drives and control were supplied by the British Thomson-Houston Co., Ltd. The consulting engineers for the electrical equipment were McLellan & Partners. The mill will roll steel strip to tinplate gauges at up to 5,000 ft/min. The stand work rolls are 21in in diameter, 42in long, with back-up rolls 53in in diameter. The tension reel has a diameter of 20in building up to 72in with a finished coil which may weigh up to 36,000 lb, and consist of six miles of material.

The electrical equipment incorporates many features resulting from experience of the design and installation of steelworks drives. In particular, the machine circuit arrangement and the stand control scheme have been well proved in an earlier installation at the Steel Company of Wales' Trostre works. Detailed improvements in the equipment and control scheme have also been made, such as the reduction in the number of small rotating machines brought about by the introduction of "Magnestats" (magnetic amplifiers), the use of high-speed circuit-breakers and the inherent automatic adjustment of speed droop between running and threading speeds.

Generators grouped in two sets, each driven by a 9,000 h.p. 11 kV synchronous motor, feed the d.c. motors for the five stands and the tension reel. Each stand motor



The general view of motor room (title picture) shows the motors for stands 1–5, two seven-unit motor-generator sets, and the exciter sets. In the photograph immediately above, the rolling mill is seen from the reel end showing the control cabinets

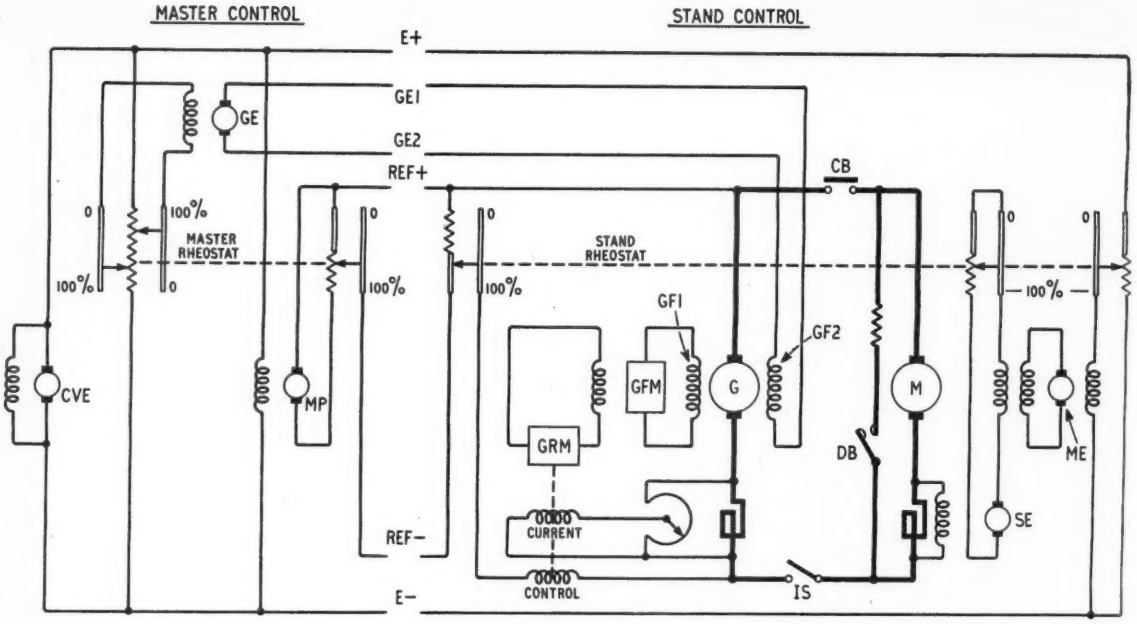


Fig. 1.—Diagram of mill speed control circuit

drives the bottom work roll reel mandrel directly. Mill speed is regulated by armature voltage control and relative stand speeds are adjusted by armature voltage and field control. The motor-generator sets, mill motors and exciters and other auxiliary machines are in a motor room beside the mill, with the supervisory control panel. In the control room above the motor room are contactor control boards, cubicle-mounted "Magnestats," selsyn-operated control rheostats, the alarm indicating cubicle and a further supervisory panel controlling synchronous motor excitation. The d.c. line panels for the stand and reel motors, and for the synchronous motor exciters, are in the basement.

The stand and reel motors are compound-wound machines with off-set pole face compensating windings to give added stability. The load regulation curve of the motors is substantially linear from zero to 1·5 times full load. The motors are capable of running at 1·25 times full load for two hours and frequent working peaks of twice full load. To keep accelerating currents and differences in referred inertia between stands as low as possible, armature inertia must be kept down, and multi-armature motors are used for stands 2 to 5 and the reel, each armature having a greater ratio of core length to core diameter than is usual in d.c. motors. The stand motors have low-inertia drum construction armature spiders, while the reel motor, which has a relatively small armature diameter, has its four armature keys welded directly on to the shaft.

Each mill motor has a tacho-generator and a mechanical overspeed device driven through a gearbox and coupling from the non-drive end. Speed indicators fed from the tacho-generators are mounted on the mill cabinets and supervisory panel. The speeds and powers of the stand and reel motors are as follows:—

	No. of Armatures	Total h.p.	Output r.p.m.	Mill ft/min
Stand 1	1	1,750	90/255	345/1,400
Stand 2	2	3,500	125/304	480/1,670
Stand 3	2	3,500	200/445	770/2,440
Stand 4	2	4,000	350/645	1,340/3,550
Stand 5	3	5,500	500/910	1,920/5,000
Reel	2	900	233/955	

Each stand motor armature is fed by a 1,600 kW, 600 V generator. A 731 kW, 650 V generator feeds the double-armature reel motor. An alternate series connection of generator and motor armatures is used for the multi-armature stand motors, giving inherent current sharing between the machines. In addition, the voltage across any part of the circuit does not exceed that required by one armature even under fault conditions. The individual generator system makes possible a wide speed range on each stand by means of voltage variation of the stand generator group, in addition to the normal field control range. It also simplifies load compensation adjustment and reduces the fault capacity of the busbar system.

Emergency Stopping

Provision is made for interruption of the motor armature circuits in an emergency by means of high-speed circuit-breakers which are capable of contactor duty on this type of application and therefore make separate line contactors unnecessary. Dynamic braking contactors are used to connect resistances across the motor armatures for emergency stopping.

The circuit-breakers are tripped either by high-set instantaneous overload relays, to deal with sudden severe mechanical overloads, or high-speed relays responding to rate of rise of armature current, to take care of electrical faults. Sustained working overloads are prevented by low-set overload relays with time delays which, when they trip, bring about a controlled regenerative stop. The operation of an electrical or mechanical overspeed device will also stop the mill by regenerative braking. A controlled regenerative stop will bring the mill to rest in the minimum time from any speed by allowing the maximum permissible regenerative current throughout the stopping period.

The synchronous motors driving the motor-generator sets are designed for reactor starting but they can be started direct-on-line if necessary; a squirrel-cage winding ensures that peak line currents are relatively low. Starting of the motor-generator sets can be completely automatic once the line circuit-breaker has been closed. After the

motor has synchronised, " Magnestat " control of its excitation maintains either constant power factor or constant kVA.

Fig. 1 is a simplified diagram of the mill speed controls. The speed of the whole mill is raised by increasing the voltage of all the generators in unison. Each generator main field consists of two windings, one supplied by an individual generator field " Magnestat " (GFM) and the other supplied by the generator exciter (GE), common to all generators. GE field voltage is controlled by the master rheostat (MR). A mill reference voltage, also controlled by the master rheostat, is set up by a master pilot exciter (MP). The master pilot exciter supplies the reference voltage dials of the stand speed rheostats, so that all stand reference voltages vary with mill reference voltage.

The variable speeds required for rolling duties (thread, high-thread, and run) are pre-set on small setting rheostats as reference voltages which affect the position of the master rheostat and hence the mill reference voltage. The mill is controlled by " thread," " high-thread," " run," " hold," and " stop " buttons on the mill cabinets. In addition, mill speed can be controlled by " raise " and " lower " buttons which accelerate or retard the mill at a reduced rate while they are held in.

Individual stand generator voltage is controlled by the generator regulating " Magnestat " (GRM) which regulates generator voltage to correspond to mill reference voltage as modified by the stand speed rheostat. Any difference between stand generator voltage and the reference voltage causes current to flow in the regulating " Magnestat " (GRM) control winding, exciting the generator main field through the field " Magnestat " (GFM), to correct the difference. Some voltage difference must exist to maintain excitation, but the amplification of the voltage-regulating loop is such that the generator voltage always corresponds closely to the reference voltage.

Load Compensation

Motor speed varies with the load current because of armature resistance. Load compensation is therefore introduced to maintain the stand speed relationship within definite limits, despite varying load, by increasing the stand generator voltage by an amount proportional to motor armature load current. This is achieved by connecting a current control winding on GRM to a circuit fed from the voltage drop across the generator compole and compensating winding. The voltage thus introduced into the GRM current control winding can be varied by a load compensation rheostat on the stand control cabinet.

The speed droop due to load is a much greater proportion of actual speed when threading than when running. To keep the ratio of these proportions within acceptable limits, a judicious blending of motor compounding and load compensation is adopted, the degree of compounding being adjusted automatically so as to have the same effect at all speed settings of the motors.

Constant tension must be maintained in the strip between stand 5 and the reel to build up the finished coil evenly and to keep the gauge uniform. With constant strip speed the reel motor must slow down as the coil diameter

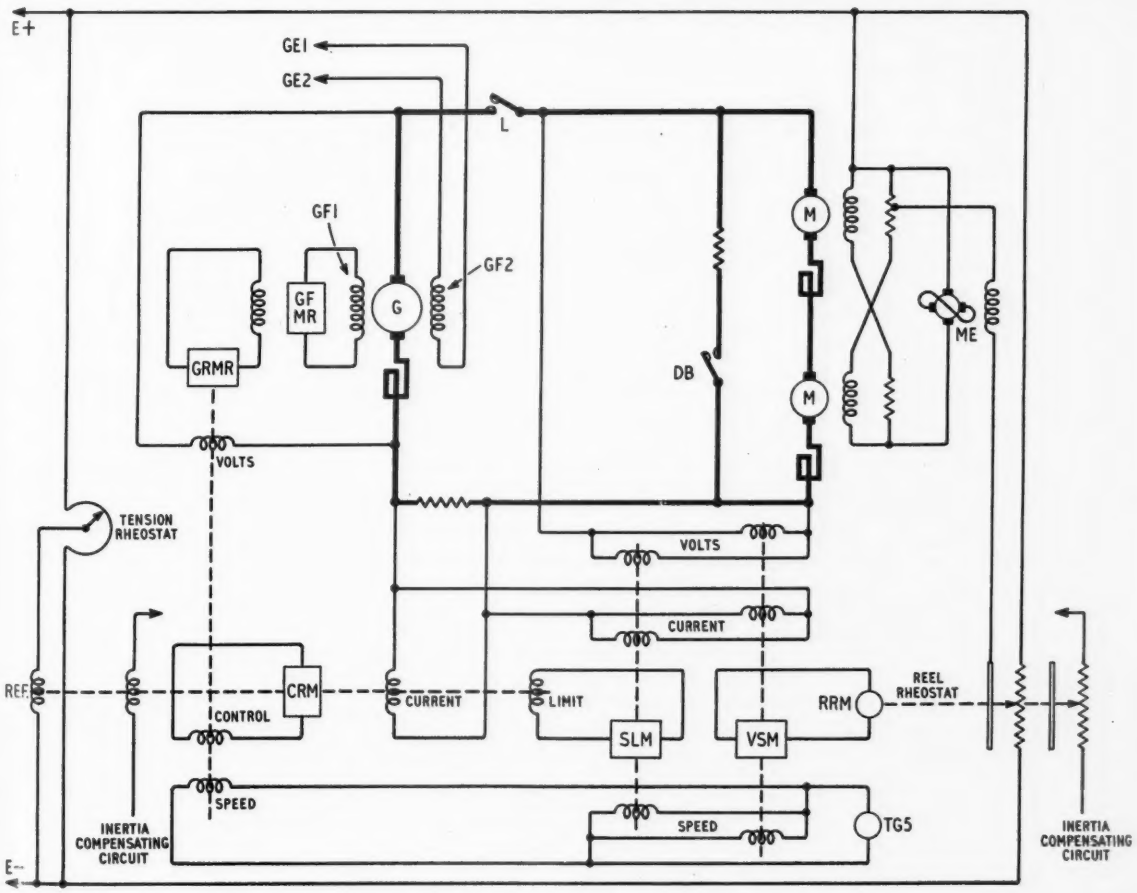
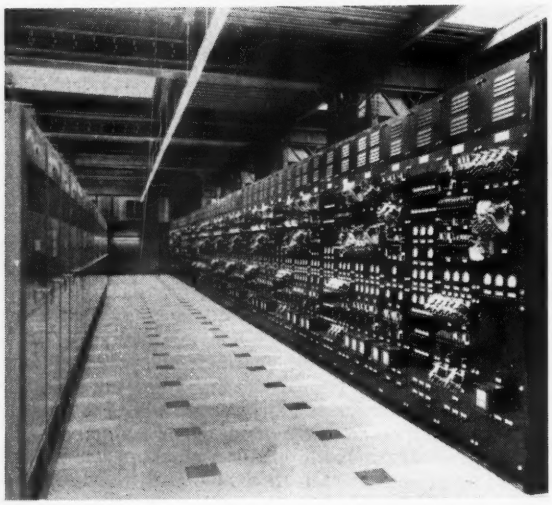


Fig. 2.—Diagram of tension reel control circuit



Contactor room, showing on the right the main contactor control panel for the rolling mill drive. On the left are the "Magnestat" regulator cubicles

increases, the necessary range of speed being obtained by field control which will allow for the increase from the 20in diameter of the reel mandrel to a maximum finished coil diameter of 72in.

The tension regulating system is based on the fact that electrical power (volts × amperes) is roughly proportional to mechanical power (speed × tension). By making the reel motor voltage proportional to speed and keeping the current constant, tension can be held at a definite value.

Referring to Fig. 2, a voltage proportional to reel motor e.m.f. is compared with the output voltage of stand 5 tacho-generator which corresponds to strip speed. As the coil builds up, the reel motor slows down and its armature e.m.f. decreases. The resulting difference between the two voltages causes a current to flow in "Magnestat" VSM, the output of which operates the reel rheostat to regulate the supply to the reel motor field. A current winding on VSM compensates for any difference between terminal voltage and motor e.m.f. on load. As the "Magnestat" is non-reversing, the reel rheostat can only move in a direction to strengthen the motor field. The position of the rheostat is always a function of coil diameter.

A current regulating "Magnestat" (CRM) compares the voltage drop across a shunt in the armature circuit of the reel motor with a reference set on the tension rheostat while the mill is operating. Any difference in excitation causes a current to flow in the reel generator regulating "Magnestat" (GRMR), adjusting the generator field, and hence armature voltage, by means of the generator field "Magnestat" GFMR to correct the error. When the mill is stationary, the reference excitation for CRM is taken from a stalled tension rheostat (not shown). An inertia compensation winding on CRM modifies the current reference to maintain tension substantially constant during acceleration and retardation.

If the strip should break tension will be lost and the motor will accelerate in an attempt to maintain its armature current. A speed limit "Magnestat" (SLM) is excited from the same sources as VSM (e.m.f. and speed). Under normal conditions SLM is cut off and VSM operates. When the motor accelerates the e.m.f. signal exceeds the speed signal, VSM cuts off and SLM comes into action, supplying a winding of the current regulating "Magnestat" to hold the reel motor speed to safe limits. Each regulating system is stabilised to prevent hunting and to give the best transient response by the introduction of transformer feedback from suitable points in the circuits into the "Magnestat" fields.

Domestic Section at Brussels Exhibition

Display Arrangements and Charges

THE Domestic Section of the Electrical and Allied Industries' collective exhibit in the British Industries Pavilion at the 1958 Brussels World Exhibition (17th April to 19th October) will take the form of a well-designed and furnished showroom in which appliances can be displayed to best advantage.

It is necessary for firms wishing to participate in this section to make a contribution to the general exhibition fund of at least £100. This will give an entitlement to full benefit from all the publicity and other facilities organised for firms supporting the project. (B.E.A.M.A. members have been asked to contribute according to their size, and contributions so far received range from £100 to £10,000.) If a firm wishes to have its own products displayed and named in the Domestic Section, additional charges will be made.

For large appliances (cookers, refrigerators, etc.) the charge will be £60 a month, £100 for two months and £200 for six months. The respective charges for medium appliances—vacuum cleaners, water heaters, fans, etc.—will be £30, £50 and £100 and those for small appliances—kettles, etc.—£15, £25 and £50.

The maximum space that can be allotted to the Section is only 1,000 sq ft, and it may be difficult to accommodate all the appliances that firms may wish to show. Efforts will be made, however, to include as representative a selection as possible, and if the demand warrants it, appliances will be changed at intervals during the six months of the exhibition.

Special arrangements will be made to provide as efficient a multi-lingual information service as possible to enable inquiries to be dealt with.

The charges quoted are not intended to cover the full cost of the Domestic Section of the exhibit, but will be a contribution towards the additional expense involved in organising such a domestic section which contrasts with the anonymous thematic nature of the rest of the collective exhibit. When all the applications have been received it will be possible to allot the available space and to notify firms of their allotment. The closing date for applications is 1st March next. Allocation of space will be made as soon as possible after that date. Applications should be sent to the Organising Secretary, British Electrical and Allied Industry Section, Universal and International Exhibition, Brussels, 1958, 36, Kingsway, London, W.C.2.

Problems of Arc Control—2

Emission Processes

By H. de B. KNIGHT,
M.Sc., M.I.E.E., F.Inst.P.*

The first part of this article appeared on pages 49–53 in the issue of 11th January, 1957.

In the cold cathode arc, processes are involved which initiate electron emission and also feed back to the cathode the energy required for continuing emission; they occur in a minute space from which current can emerge at a density of over a million amperes per square centimetre. For the arc spot on mercury, Lamar[8] estimated that a voltage fall of not more than 10 took place across a space of $1{\cdot}76 \times 10^{-4}$ cm. Photographs taken by Smith[33] indicated a dark space of about 0·001 cm at the cathode surface, beyond which was a negative glow about 0·004 cm thick.

The cathode spot apparently holds, in a confined space, a very high density of various particles, electrons, positive ions, negative ions (possibly) and neutral atoms, excited and unexcited. These are all in random motion and any of them may cross the narrow dark space and reach the cathode (including high energy negative particles, in spite of the electric field). Which of them communicates to the electrons the energy they need for emission? Is the transfer by direct contact or through the medium of photons released, for example, when excited atoms return to stability? Emission could be thermionic, if the energy released could raise the mercury to a high enough temperature, but the mercury would boil long before this temperature was reached. Various estimates have been made of the arc spot temperature, and the figure of 200 deg C given by Compton[34] in 1931, is generally believed to be at least of the right order.

One possible explanation of the emission is offered by Langmuir's[35] field theory according to which electrons are pulled out from the cathode surface by the field due to the incoming positive ions. This explanation is not favoured, however, because the field required would be about 10^6 V/cm, much higher than is to be expected with the observed potential drop of about 10 V across a space of the dimensions measured. The argument is probably not much affected if we accept St. John and Winans' estimate[27] of 20-30 V as the potential fall at the cathode.

Smith[36] has suggested that the energy carriers are high-speed electrons returning against the field and giving up their energy directly to the conduction electrons in the cathode material. The latter would thereby reach energies corresponding to a temperature of 4,000 deg K, would emit light as an incandescent body, and be able to escape through the surface barrier; in addition they would transfer some energy to the "atomic constituent" of the mercury in the excited region, enough to raise its temperature to around 150 deg C.

According to a theory proposed by Robson and von Engel[37] the particles responsible are excited atoms, which, being electrically neutral, are unaffected by the electric field, and could cross the very narrow space and reach the cathode before losing their excitation energy.

The cathode will receive some energy from photons and some from the impact of positive ions, but neither is likely to play any great part in the emission; the ions are accelerated through only a small potential drop, in contrast to the much higher potential which speeds them towards the cathode of a glow discharge, and in which they play an important part in inducing emission.

For all that is known for certain, all these influences may collaborate in producing emission, and arc instability may arise when one of them is variable or absent.

The starting of the arc is one of the major problems of arc control. This is surprising, in view of the steps that are sometimes taken to prevent it when not wanted, or in the wrong direction; but it is understandable, in the light of Mierdel's observation,[16] that if the arc is interrupted, by removal of the electric field, for as short a time as 10^{-9} sec, the processes collapse and the arc does not restrike on re-application of the field.

When an arc spot is to be kept continuously alight, passing a current to an auxiliary anode, it can be formed by the dipping ignition rod method, and timing accuracy is unimportant. With synchronous ignition, as in the single-anode ignitron, the arc is struck afresh in each positive half-cycle in which current is desired, and precise timing is necessary.

Many methods of arc initiation have been tried. They reflect the observations and theories of the cathode spot processes; and the imperfect understanding of these is illustrated by the unreliability of many of the methods proposed and their non-appearance outside the patent literature.

Attempts have been made to initiate the cathode spot by means of a high-voltage breakdown to the cathode from an auxiliary electrode; such a breakdown can be produced in the form of a glow discharge, but its transition to an arc, with the all-important cathode spot, is not to be relied on. Some years ago the principle was applied to multi-anode rectifiers having a potassium/sodium amalgam cathode and a gas pressure of some hundreds of microns of argon.[19] The high pressure enabled the device to work, with a satisfactory transition from a glow discharge to an arc, but it also restricted the possible anode voltage range. The principle is in use in present-day valves of the strobotron type,[38] in which the cathode is activated with cæsium and the gas is neon or argon.

Arc initiation has been encouraged by the provision of localised high pressures; by obliging electrons to follow spiral paths in combined electric and magnetic fields, to ensure a copious supply of positive ions; and by concentrating ions (from an independent arc to a hot cathode, or from a high frequency discharge) on to a point on the cathode pool by means of electric and/or magnetic fields. In the light of existing theories of the arc spot these are

* British Thomson-Houston Co., Ltd.

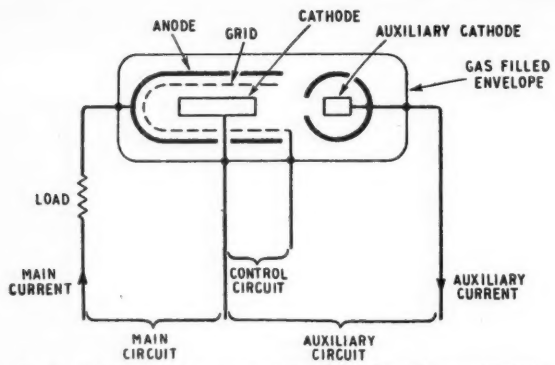


Fig. 9.—Diagrammatic representation of the electrode arrangement and circuit connections of a triode-type plasmatron

sound ideas to try; but the much-desired spot on the cathode is elusive. Haworth[39] showed that an arc could be started by projecting positive ions at a cathode whose surface was contaminated by insulating specks; but this is not easily applicable to a clean mercury surface.

The " capacity " type of ignition, by means of a fairly high voltage (generally 1,000 V or more) applied to a conductor separated from the cathode surface by an insulating member, can give reliable, synchronous firing. The method has been tried in a variety of forms, but not, so far, with a satisfactory life, early failure being generally due to deterioration of the insulator, its surface becoming either damaged or covered with conducting material.

The semi-conductor ignitor, already briefly described, is the most satisfactory arc-initiating device now available, for it combines precision of timing with long life. It illustrates both the practical and the theoretical problems of arc ignition. The ignitor must be made of as small a diameter as feasible, to reduce the igniting current requirement; but it must be robust enough to withstand the mechanical forces due to the movements of the mercury pool. It must operate when cold, at first starting, and also when hot from continuous proximity to the main arc at full load. Further, it must function at immersion depths varying over a wide range, because the mercury level changes with load on account of evaporation, and also, continuously, with the sometimes violent agitation of the mercury surface by the arc.

The materials used in the construction of such an ignitor must be inert to mercury, able to stand high temperatures, suitable for sintering and forming to a rod of the required shape with a resistance falling in an agreed range and not decreasing too much under full anode-load conditions. It can readily be supposed that this sets ample problems for the manufacturer.

One standard form of ignitor operates reliably if connected in a circuit which can apply up to 200 V when the ignitor is cold or pass a momentary peak current of up to 30 A (average less than 1 A) when it is hot; the current must be unidirectional. There is scope for an ignition device which can operate reliably with alternating current, and at a level of milliamps instead of amps.

The ignitron ignitor is a valuable and reliable device, in spite of its mode of operation not having been established with certainty. Electron emission must take place from the cathode at the point of immersion; here the mercury meets the ignitor with a convex meniscus, so that there is a region in which the liquid and solid are separated by a narrow radial gap. Slepian and Ludwig,[1] the inventors, proposed the theory that operation was due to the high potential gradient at this point; they calculated that the field could reach the 10^6 V/cm required for field emission of electrons. Other theories[40,41] suggest intense localised heating of the mercury by current passing into it at small, prominent spots on the ignitor surface. Whatever the emission process, it is likely to be assisted by the locally increased vapour pressure, reduction in surface tension, and rupture of the contact at the meniscus by vapour bursts and by movement in the electric field.

Consistent with such theories are the observations that ignition can sometimes be assisted by raising the temperature of the ignitor or by relative agitation of the ignitor and the mercury surface. Theories must, however, take into account Slepian's observation that his semi-conductor ignitor can operate to initiate an arc even when frozen into solid tin, a condition under which the rupture of contacts or the rapid development of high vapour pressures may be difficult to visualise.

The Thermionic Cathode

In the thermionic cathode, as used in thyratrons, electrons are emitted from metal surfaces which are coated with substances of low work function and heated to a temperature around 1,100 deg K. The design is essentially similar to that described by Hull[42] in 1929. The indirectly heated cathode has advantages in efficiency and long life and in presenting a unipotential emitting surface. The directly heated cathode has come into wider use, however, in recent years, because, with the greater use of permanent gas fillings, such as xenon, instead of mercury vapour, it is possible to realise the advantage of a short delay time for cathode heating. Emission is thermionic, and if long life is desired for the cathode care must be taken to avoid electron release by the mechanisms appropriate to the cold cathode.

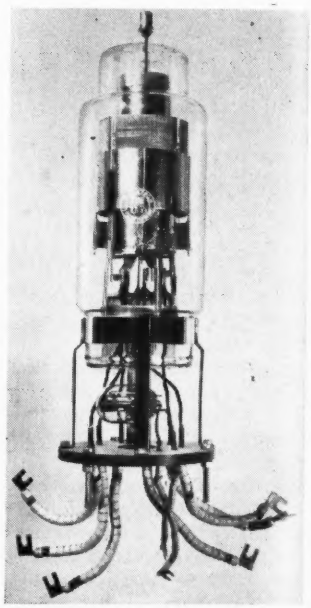


Fig. 10.—Multiple grid hydrogen filled thyratron

Various "dispenser" type cathodes have been proposed,[43] but have not gained favour in arc valves, largely because cathodes of the existing design are cheaper to construct and have proved adequate as regards capacity and life. Some modifications to the emissive coating have taken place to provide a higher ratio of peak-to-mean current capacity, especially for valves for motor-speed control. In some designs, for example, the familiar barium-strontium oxide coating is modified by a nickelate addition, as described by Coolidge.[44]

Continuous Control and Arc Quenching

The usefulness of the arc for current control would be greatly extended if the arc could be stopped at will by grid control, or if the arc current could be varied in relation to the grid voltage, as in a vacuum valve. Attempts to achieve such control have met with some success, but so far there is no prospect of its wide application.

The application of a negative voltage to a grid can

prevent the arc from starting between anode and cathode; but when once the arc is established a negative grid normally has no further control because its surface becomes covered with a positive-ion sheath, inside which the field due to the voltage on the grid is confined. The thickness of the sheath varies inversely with the arc current and with the vapour pressure, and directly, though only slowly, with the applied grid voltage. The arc can be quenched if the grid voltage is high enough for the ion sheaths at adjacent grid boundaries to overlap, filling the grid apertures. This can be demonstrated in principle, with small industrial thyratrons of standard design[45] but any practical application requires carefully controlled electrode dimensions and spacings.

In a study of the phenomenon, with a 1 A arc to a hot cathode in mercury vapour, Fetz[46] distinguished two mechanisms. At lower pressures (for temperatures up to 30 deg C), on the application of the negative grid voltage the ion sheaths restrict the available aperture area, and the total anode to cathode voltage drop increases by the amount of the voltage drop across the restriction, which varies with the applied grid voltage. At a certain degree of restriction the arc goes out, not because of complete closure of the aperture but because instability sets in. The instability could be prevented by back-coupling the arc-drop to the grid circuit. The anode-cathode voltage could then be varied at will, for values up to several hundred volts by varying the grid voltage, with a linear relation giving a power amplification of 100 or more.

At higher pressures the arc tends to concentrate, and extinction must be achieved by sudden and complete closure of the grid holes by rapid application of a negative grid voltage. In Fetz's experiments some thousands of volts were applied in 10^{-7} sec. The quenching voltage required varies inversely with the time of application and is much higher for 10^{-6} sec.

The Plasmatron

This method of current control is generally limited to current densities and gas or vapour pressures which are not useful for most arc control requirements. Also the extinction of an arc current in 10^{-7} sec introduces the hazard of high voltage surges across inductances in the circuit.

A different approach to the problem of continuous control is that of the "plasmatron."[47] Fig. 9 is a diagram of the electrode arrangement. In this valve the plasma between the anode and the hot cathode is provided by diffusion of charged particles from a separate discharge established between the cathode (here acting as anode) and an auxiliary hot cathode. As, under these conditions of operation, the main discharge circuit does not have to supply the energy to establish the plasma, the voltage drop between anode and cathode is very low. The plasma is a good electrical conductor; its conductivity may be varied, and with it the current passed in the outer circuit, by varying its density, and this is a function of the current in the auxiliary discharge. Valves have been made to pass currents up to 1 A in a d.c. circuit, and current may be continuously regulated by control either of the current (a few mA) in the auxiliary circuit or of a voltage (a few volts) applied to a grid between the main anode and cathode. Amplification is said to be linear for frequencies up to 10 kc/s for the diode, or over 100 kc/s for the triode.

A limitation of present designs is that the voltage between anode and cathode must not exceed the ionisation potential of the gas, as otherwise an uncontrolled discharge would develop there. This limits the output circuit voltage to about 10 V for a mercury vapour filled plasmatron, or 24 V for one with helium. In its present form, the valve is somewhat limited in power handling capacity, but its frequency response and low voltage loss make it attractive; it may point the way to higher power developments.

Rate of Current Rise

When voltage is applied to a circuit containing an arc discharge valve, the rate of current rise is limited not only by the impedance of the circuit, but also by the speed with which ionisation can progress in the valve itself. The latter limitation may be dominant if the gas or vapour pressure is too low,[15] or if the electrode structure in the arc path is unsuitable.[45] In the hot cathode thyratron, higher rates of current rise are obtainable with hydrogen than with mercury vapour because of its greater mobility. The hydrogen-filled thyratron[48] illustrated in Fig. 10 is rated for a current rise of 5,000 A/μsec. With a mercury-pool cathode, however, high rates of rise are possible; Froome[28] recorded values of 1,000 A/μsec. This is an advantage of the ignitron as a modulator valve for recurrent pulses of short duration, and it is believed to be due to the very high vapour pressure in the immediate vicinity of the free cathode spot.

In the operation of hot cathode valves, although the rate of rise of current may be very high, it should be limited by circuit design as much as possible, to reduce to the minimum the damaging positive-ion-bombardment the cathode may receive during current build-up.

It is often important to have accurate timing of the commencement of current pulses, and sometimes more important to have a minimum difference in timing—known as "jitter"—between successive pulses. This is a problem of the time delay before current commences, after the initiating signal has been applied. With pool-cathode valves of the ignitron type, the time delay can be reduced by applying high firing-energy to the ignitor. Greater precision is obtainable, however, by establishing a priming discharge just ahead of the power pulse, and timing the latter by the use of grid control, as is possible with the pentode type of ignitron shown in Fig. 6 in Part I of this article.

A similar method is applicable to hot cathode thyratrons by the use of a priming discharge from an auxiliary grid just ahead of the application of the arc initiating signal to the control grid.[45] Fig. 11 shows the effect in a mercury vapour valve. Such an arrangement, applied to the BT.103 hydrogen-filled thyratron (Fig. 10), so reduces the time delay between grid signal and anode current that the jitter is less than 0·002 μsec.

A key to the references will be appended to the last part (III).

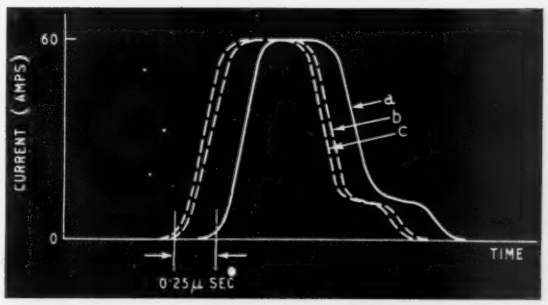


Fig. 11.—Experimental observation of the effect of pre-ionisation in reducing the time delay in firing of thyratrons

1 μsec current pulse through a CV22 mercury vapour thyratron in a modulator circuit discharging an artificial "line" at 15 kV into a slightly mismatched load. Ionisation is established in the grid/cathode space from an auxiliary electrode just before firing pulse on grid. (a) With no pre-ionisation. (b) With pre-ionising current of 20 mA. (c) With pre-ionising current of 200 mA

Linear Electron Accelerators

AN investigation of anisotropic-dielectric-loaded linear electron accelerators undertaken by R. B. R. Shersby-Harvie (Service Electronics Research Laboratory) and Messrs. L. B. Mullet, W. Walkinshaw, J. S. Bell and B. G. Loach (Atomic Energy Research Establishment) was described to the Measurements Section of the Institution of Electrical Engineers on 8th January.

The aim was to devise a waveguide less wasteful of radio-frequency power, dissipated as Joule heat in its walls, than was obtainable with the all-metal corrugated construction. This meant primarily a waveguide having a higher shunt impedance, defined as the square of the electric accelerating field divided by the power absorbed per unit length.

The paper was based on theoretical and experimental studies which indicated that a substantial reduction in losses could be achieved through the use of anisotropic dielectric loading, which could be simulated by spaced discs of ordinary dielectric finely laminated. Evacuation of the system necessitated the use of a mercury-diffusion pump and not an oil-diffusion pump, which caused excessive attenuation attributable to a secondary-emission resonance (" multipactor effect ").

Measurement of electron energies showed the electrical field in the waveguide to agree closely with the theoretical value. Similar agreement regarding attenuation showed that the theoretical shunt impedance might be twice that of an all-metal waveguide. The conclusion was reached that larger and more complex waveguides could be developed on these lines. The metal portion would be essentially a circular tube which required only accurate machining of the bore. The dielectric discs would be of low-loss ceramic and small changes of phase velocity would be obtainable by varying their spacing.

DISCUSSION

Opening the discussion on the paper, Dr. G. B. Walker (Queen Mary College) said it was always very exciting to be in on a " first," and this was the first dielectric-loaded linear accelerator to be constructed and operated, and it was certainly the result of an extremely fine piece of teamwork. There were only two criticisms which might be raised, the first being the very great delay in publishing the work, which had been completed at least three years ago. The second criticism really amounted to a plea for more information on the other sorts of loading, because it seemed that anisotropic disc loading of the sort which had been discussed was rather limited in the amount of advantage one could expect and was also open to certain practical difficulties.

One great difficulty was to form a proper assessment of the exact effect of anisotropic loading: there were so many variables that it was difficult to evaluate correctly the various parameters. A point which had not been made in the paper was that by using discs with air spaces one produced a system which had the greatest possible difference between the radial direction and the longitudinal direction.

A comparison with other systems of loading was difficult and complicated, but there was no doubt at all that loading by solid tube was not a good system. When compared with the conventional type of disc loaded linear accelerator the anisotropic system had a small advantage —it might be as much as a factor of 2—but it would be possible to invent a metal system which would be more efficient, although more difficult to construct, than the existing metal system.

In regard to the other systems which the authors had hinted at, his own experience had been that better reflections were obtained from ceramic surfaces than from metal, and in his opinion that was the direction in which significant advances in linear accelerator efficiencies were likely to be obtained.

Mr. P. Howard-Flanders (Hammersmith Hospital) said the authors had mentioned the possibility of using materials of high magnetic permeability, and he wondered whether that was not now a more feasible proposition than it was at the time when they embarked on the dielectric structures. With regard to the effect of prolonged electron bombardment, the dose rate could be extremely high and in an accelerator used for any period one wondered what would happen to the dielectric material, at any rate near the output end.

Dr. Denis Taylor (Atomic Energy Research Establishment) said it would be interesting to know whether that system was going to be taken up at all in connection with the design of linear accelerators for medical work or for nuclear physics work, or whether people were satisfied with the corrugated type of metal waveguide which had been used so far.

Mr. A. D. Cutting (Standard Telecommunications Laboratories), referring to the multipactor effect, said he noticed that all the metal used in the vacuum part of the system seemed to be brass, and it was more than likely that the trouble arose from the zinc in the brass rather than from the oil, and the use of copper might obviate the trouble.

Major Fugl wondered whether the two types of linear accelerator were the only known methods of slowing the velocity of waves below that of the speed of light.

Mr. Lewin (Standard Telecommunications Laboratories), referring to the use of material with a high permeability, said he assumed that would be in relation to a ferrite material, and since the accelerator was immersed in a very strong magnetic field he wondered whether that had been considered in connection with the gyromagnetic effects which would then arise.

Mr. G. W. Bowdler (N.P.L.) said he had been struck by the large amount of power which was dissipated in the walls of the guide and also the comparatively short length of the accelerator tubes, and he wondered whether both in the all-metal and the dielectric-loaded guides the authors had considered the possibility of reducing those losses by surrounding the wall of the tube with liquid air.

Dr. J. Mason (E.R.A.) said he was interested in the remark made in the paper to the effect that the dielectric discs showed all the usual colour effects and carbon deposits associated with an oil-diffusion pump system, together with a distinct brown discoloration, and he wondered whether it was due to the fact that the electron bombardment had cross-linked some of the oil particles in the system so that one effectively had a deposit of a polymer, which was in itself causing a change in the dielectric characteristics of the system.

Mr. R. Beadle (Mullard Research Laboratories) said the thing he would like to know more about was the more complex method suggested by the authors of producing the high shunt impedances, and just how complex that system could be.

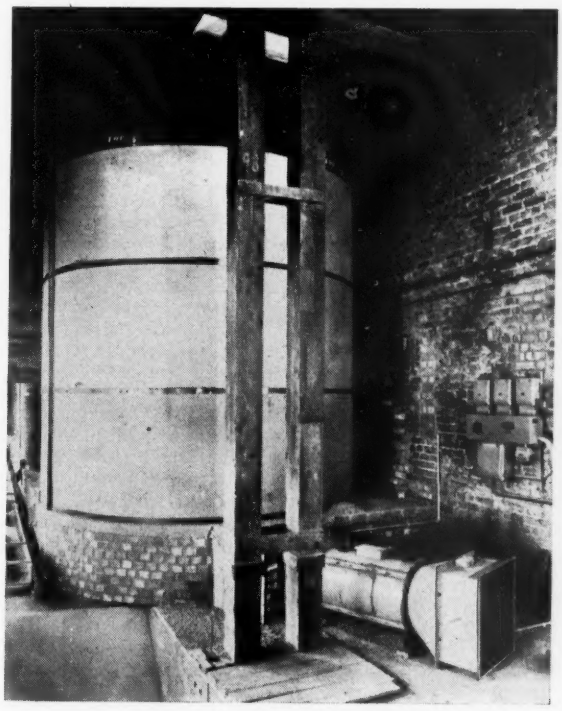
Electricity for Crop Drying

IN a recent lecture on electricity for crop drying, Mr. William Cover (Agricultural Department, General Electric Co., Ltd.) said that although in the past many farmers had considered that they could get through the harvest without a dryer, experience in 1952, 1954 and 1956 confirmed that such equipment was a necessity. Furthermore, even in an average year a dryer could very materially help in safely gathering the harvest. The intelligent use of the combine harvester could reduce the amount of grain that had to be dried but even in favourable seasons the moisture content of much of the grain as harvested was too high for safe storage during the winter months.

The type of drying plant to be installed depended on local conditions and requirements. If the grain was handled and stored in sacks the general consideration would be to dry in sacks on platform dryers or in some cases on a tray dryer. If grain was handled in sacks but stored in bulk, consideration should be given to platform, tray and silo dryers. Where the grain was handled and stored in bulk, silo drying would generally be recommended. There were exceptions to any generalisation, but as a guide platform or tray grain drying should be adopted up to, say, 150 tons and silo grain drying up to 500 or 600 tons and perhaps more.

The electrical equipment used for platform, tray or silo grain dryers was very similar. An electric heater was used to warm the air and a fan, generally aerofoil axial flow, blew the warmed air through the grain to be dried. It was necessary to have switchgear to control the operation of the fan and heater unit and this was supplied as a self-contained control panel. The essential difference between equipment used for platform and silo grain drying was the rating of the fan, because with the increased grain depth in silos the fan must develop more pressure to force the air through the grain.

G.E.C. 6½ h.p. 21 kW grain drying plant with self-contained control panel used with simplex drying bins



Typical G.E.C. platform grain dryer

Platform Grain Drying

Electric platform grain dryers were low in capital cost, did not require a separate building and could be installed with very little structural alteration. The sacks of grain were laid on a concrete platform usually constructed of precast concrete slabs having openings approximately 2ft by 1ft with some form of grille. Beneath this platform there was a low pressure plenum chamber into which the fan blew air about 25 deg F above ambient; this air dried the grain by passing through the sacks. The rate of drying was dependent upon the design and operation of the plant, and particularly on the air speed through the sack. Standard plants had average drying capacities of from 2 to 12 tons per day, assuming that the plant was operated 24 hours per day, and the moisture extraction was between 4 per cent and 6 per cent.

Tray and Silo Methods

The tray grain dryer was generally a shallow tray suitable for a grain depth of 9in to 12in. The bottom of the tray was of wedge wire, perforated metal or similar material. Air was blown into an airtight chamber beneath the tray and passed through the tray bottom and through the grain. This was a useful small batch dryer and a typical tray had a capacity of about 1 ton of wheat with a drying rate slightly over 1 per cent per hour.

The technique of drying grain in perforated floor silos, which had been developed during the last fifteen years, was now well established. Drying in a perforated floor silo would not be carried out any quicker by further raising the temperature of the air, as this would cause over-drying of the lower layers and delay drying of the bulk, which was a condition to be avoided.

During the last two years a silo or bin with perforated walls had been available to farmers. A perforated drying

cylinder might be placed in the centre of the bin the grain filling the space between the drying cylinder and the perforated walls. During drying, air was blown into the cylinder, radially through the grain and discharged from the silo walls. Owing to the smaller grain thickness—with a bin 7ft 6in in diameter it was only 3ft—a faster drying rate could be obtained than for the usual floor-ventilated silos with a 10ft grain depth, and the power necessary to drive the fan was reduced. An example of this perforated wall silo was the simplex silo, which was constructed in sections from expanded metal.

The grain was brought from the combine harvester in the field either in bulk or in sacks, and the first need was a wet grain pit of sufficient capacity to receive each load of grain. Grain flowed into the boot of an elevator from which it was taken to the drying and storage bins by pneumatic or mechanical conveyor. The grain would later be emptied from these bins to a hopper feeding a grinding mill or to a bagging-off point.

Farm Crop Drying

For some time it had been apparent that many farmers, particularly those with a small acreage of crops, wished to dry and store for their own use, grain, seeds, grass and hay, and for this purpose the G.E.C. marketed a multi-purpose dryer. This was originally based on the platform grain dryer, but there had since been several alternative forms of construction. The average drying time would be some three days and of this two days were used for cold air blowing and one day for warm air. The average cost of drying with electricity at 1d/kWh was £2 10s per ton of dried material. There was another method known as barn hay drying in which cold air only was used for drying and, depending on the height in the barn, some two or three loadings would be made and the total drying time would average two to three weeks at a cost for electricity of less than 20s per ton of dried material.

Advantages of electrical methods were:—(1) Compact fan and heater unit, which could be installed in a confined space. As the fan impellers were mounted on the motor shaft there was no belting and no need to prepare special foundations. (2) Drying air could not become tainted with products of combustion. (3) Maximum temperature rise was limited by the rating of the duct air heater and fan unit and also by the conditions of use. This could, if desired, be controlled automatically. (4) Heat was instantly available at the touch of a switch. (5) Supervision was reduced to the minimum. (6) Compared with alternative methods, the capital cost was low.

PLAN FOR A DORSET "HARWELL"

A PUBLIC inquiry lasting three days was held at Dorchester last week into a plan of the United Kingdom Atomic Energy Authority to build a new research establishment on a 688-acre site at Winfrith Heath in Dorset. The inquiry was conducted by Mr. G. D. Buchanan, an inspector of the Ministry of Housing and Local Government.

The scheme was supported by the Dorset County Council, which has already granted planning permission, and by the district councils concerned, as well as by the local trades councils. The main opposition was from the Dorset Land Resources Committee, an organisation of landowners and nature preservers formed after a public protest meeting. It was stated that 2,000 people had signed a petition for the inquiry to be held. The Committee feared that the establishment would lead to the industrialisation of an essentially rural county. Reference was also made to the area's associations with Thomas Hardy.

Giving evidence on the opening day, Sir John Cockroft, director of the A.E.A., said that the Harwell establishment had been developed to a stage at which it could not be expanded without overstraining the facilities of the area. Before the Dorset site was found 70 possibilities had been investigated. If the Minister refused planning permission the Authority would have to start the search all over again and the delay would be serious from the national point of view.

Besides new and improved types of nuclear stations to produce power more economically they were developing ship propulsion and small nuclear power units for export. They were also working on the fascinating project of drawing power in a controlled way from the abundant light elements such as the isotopes of hydrogen, although that was long-term research.

They would continue with their basic and technological research at Harwell and would go in for reactor research and development at the new site. It was intended to build about six small-scale experimental reactors, probably of the size of "DIDO," over the next ten to twelve years. In addition, the Authority would build a number of small-scale experimental process plants to study methods of making atomic energy materials, such as special grades of graphite for reactors and heavy water.

In reply to Mr. J. H. Inskip, representing the Southern Sea Fisheries District Committee, Sir John said he thought it unlikely that crabs and lobsters would be harmed because the radioactive waste would be so diluted by the action of the sea that if the sea were fresh water it would be possible for a person to drink it without harm. Later, Mr. C. Bowles described experiments proving that no harmful concentration of radioactivity would develop. He calculated that even if a man should eat 2½ kg of lobsters reared near the discharge outlet each year of his life he would only accumulate the maximum possible body burden of radioactivity after 70 years.

For the A.E.A., Mr. G. D. Squibb said he had wished to call the country's greatest expert on lobsters and radioactivity but had been prevented from doing so by the Ministry of Agriculture and Fisheries because the Ministry did not wish a member of its staff to give evidence at an inquiry held by another Government Department.

Colonel G. W. Raby, deputy director (engineering), A.E.R.E., Harwell, said that he and his assistants had examined about 50 sites without being able to get agreement from local authorities, or else there was some obstacle.

The Council for the Preservation of Rural England's objections to the use of the Dorset site were presented by Mr. R. K. Arkell, who said that the coastal area south of Winfrith Heath was one of the first stretches of unspoilt coastline west of Ramsgate. While agreeing that the site was the best in Dorset for the purpose, he argued that it would be better to put the establishment in some other county. On this point Dr. Glyn Phillips, of the Welsh Economic Development Council, and Mr. J. Kegie, planning officer of the Monmouthshire County Council, said that several suitable sites could be found in Wales and Monmouthshire and that such a project would be welcomed in their areas.

It was stated that 13 conditions were attached to the Dorset County Council's consent. Mr. Squibb said that if the work of the establishment became subject to the Official Secrets Act this would override everything else, but as far as could be seen this would not happen. The Authority would accept all the conditions except one which required that 40 per cent of the water taken from the River Frome should be returned to the river near the site of the proposed establishment.

VIEWS on the NEWS

By REFLECTOR

IN commenting on the recent inauguration of the Shenfield-Southend electrification scheme the *Daily Telegraph* implied that much more should have been done in this country before this; Switzerland's railways were electrified more than thirty years ago. It went on to say

> "But even if we in Britain could afford this process, we might do well to wait. Atomic energy will, we are assured, make electricity as extinct as the Rocket (old style)."

I did not think that anybody would have taken this seriously but perhaps it is just as well that Sir Ben Lockspeiser has taken the point up. He refers to the general agreement that the supply of electrical power from nuclear reactors must be proceeded with to reduce our dependence on coal and oil. In this context British Railways' electrification plans appear to take advantage of the technological possibilities of atomic energy in the most economical way. Sir Ben points out that "the alternative is the atomic locomotive, but as an economic proposition (apart from such matters as coping with radioactive products in the event of a crash) it does not bear comparison."

* * *

Without any special efforts to "sell" it, floor warming appears to be rapidly gaining favour. At a meeting of the Eastern Electricity Consultative Council last week, Alderman W. J. Bennett, the chairman, told members that the system was proving a great success in the Board's area, and looking through the various progress reports submitted to the Council I found ample confirmation of this. The Northmet report, for example, mentioned a 52 kW installation for an engineering company and others in houses at Enfield and flats at Hornsey. In Suffolk, the system is being installed in new offices at Harwich and a presbytery at Beccles, while the Board itself has its new service centre at Aldeburgh heated in this way. The largest installation referred to is one of 100 kW in offices at Romford occupied by the Essex County Council and in the same town a 24 kW installation has been provided in a hairdresser's establishment—indicating the varied nature of the premises in which floor warming is being used.

* * *

There is a great deal of profitless discussion about the priorities of atomic power. The Russians claim that their 5 MW plant, which has now been running for about two-and-a-half years, was the first full-scale nuclear power plant. But what is "full-scale"? The Calder Hall station was said to be the first really practical supplier of power but because the primary purpose of the station is to produce plutonium doubts have been expressed about its claim to be a "commercial" undertaking. As its surplus power is sold to the C.E.A. these doubts are hardly justified. Now the C.E.A. itself has placed orders for two "full-scale" atomic power stations which it has described as the first, although the South of Scotland Electricity Board is running parallel with the Authority. Work on the Bradwell, Essex, site was inaugurated this week but *Topic* (the monthly newspaper of the A.E.I. Group) claims that "Berkeley will be the world's first full-scale commercial nuclear power station." It is evident that all the parties concerned are engaged in a race to get their stations going which is all to the good in view of the need.

* * *

Some concern has been voiced about the possible effect on the lobsters on the Dorset coast if the Atomic Energy Authority is permitted to place its proposed research establishment in the county. For the Authority it has been said that the amount of radioactivity in the discharge from its establishment would be negligible. As a measure of this negligibility it is stated that experiments have shown that if a man consumed 2½ kilogrammes daily of the lobsters living near the discharge point it would take him seventy years to accumulate in his system the maximum permissible amount of radioactive material. I imagine that anybody who went on to this sort of diet would perish from indigestion long before he had a chance to prove the point.

* * *

At a time when the electrical industry is one of the soundest in the national economy it is well to remember that half a century ago it was in a very different position. The *Electrical Review* in its leading article of 18th January, 1907, started:—

> "That the electrical industry is in a precarious condition will be denied by no one. It is true that in some branches of electrical manufacturing there has been a modest degree of prosperity, but it is equally true that the manufacture of machinery has become distinctly unprofitable."

Several reasons were adduced for this. There was a great deal of price cutting among firms competing for the favours of municipal electricity suppliers—"whose methods of payment and general attitude towards contractors are in no sense helpful to a struggling industry." There were too many firms engaged in the business and although there was a considerable demand for heavy electrical machinery there was over-production. As to the remedy the *Review* said:—

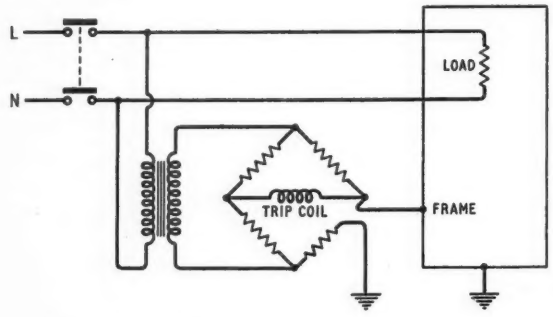
> "No one can deny that an understanding among manufacturers as to minimum prices would have prevented much of the ridiculous rivalry which exists to-day, because, while everyone admits the desirability of competition, even the keenest buyer must deplore the absurd prices which exist."

It was feared that attempts which were being made to bring manufacturers together to correct prices would not succeed in the face of the opposition of two or three big firms. There was already in existence the National Electrical Manufacturers' Association, the precursor of the B.E.A.M.A., but apparently it was ineffective in this respect.

Protective Multiple Earthing

ADDRESSING a meeting of the Association of Supervising Electrical Engineers on 15th January, Mr. S. J. Emerson (Senior Electrical Inspector, Factory Department, Ministry of Labour and National Service) discussed the use of multiple earthing of the neutral conductor to provide earth-fault protection where the normal method of direct earthing was economically inapplicable. Such a condition usually arose, he pointed out, in rural areas where values of earth resistance were high owing to the absence of networks of metallic water mains or where supplies were given by overhead lines so that there was no fault-current return path to the sub-station neutral by the armour and sheath of the supply authority's cable.

The best alternative, the author considered, was to run a fifth overhead conductor. This expedient might be costly, so protective multiple earthing had been adopted in several countries. On this system the frames of electrical apparatus were solidly connected to the neutral conductor, which was earthed at several points. A major defect of this method was that, unlike the direct-earthing



Improved method of connecting earth-leakage circuit-breaker

system, it could create a widespread danger zone because interruption of the neutral would cause a rise in its potential beyond the point of fracture.

Nevertheless, experience in Germany, U.S.A., Canada, Australia, New Zealand and Eire, concerning which some particulars were given, indicated general satisfaction with its performance when properly applied and used. While opinion was not unanimous in Germany, where P.M.E. ("Nullung") had been most extensively adopted, most undertakings preferred it to other methods in spite of the complications it introduced.

In Great Britain the position was governed by conditions imposed by the Ministry of Fuel and Power under the Electricity Supply Regulations, 1937. Experimental installations had been set up in some rural districts, but each network supplied only a small number of consumers, which the author regarded as the correct practice. He also held that no widespread promotion of P.M.E. should be undertaken until much more experience had been gained. The system had to be adopted for a whole network or not at all and could not easily be discontinued.

The potentialities of earth-leakage-trip circuit-breakers (about which in their present form opinions were mixed both here and abroad) had not yet been fully explored. The tendency to concentrate on cheapness for a device responsible for safety was fundamentally wrong. The whole of the delicate trip mechanism and the coil ought to be enclosed in a hermetically-sealed chamber, but there should be no difficulty in producing a replaceable cartridge to meet this requirement. When completely reliable earth-leakage circuit-breakers became available the outlook would be revolutionised and the intricacies associated with P.M.E. would be avoided.

Methods of connecting such breakers had not been developed to an appreciable extent, but improvements could be obtained by very simple means. In one example shown the circuit-breaker would trip if the earth conductor were broken or if the resistor exceeded a given set value; also sensitivity could be increased to an optimum value without using a very delicate coil with a fine gauge of wire. In the protection of industrial circuits more especially, the differential-current earth-leakage breaker offered considerable promise. The possibility of easily obtaining discrimination between circuits gave it a great practical advantage over the voltage-operated type.

Cooker for a Cripple

DISABLED people who cannot do their own cooking because they are permanently confined to wheelchairs may benefit from a new idea for electric cooker design by Mr. J. Lales-Allen, superintendent of the South Western Electricity Board's Torquay repair depot.

Recently, in Devon, a mother of two children who is paralysed in both legs so that she can only move about her home in a wheelchair, found that she was unable to cook for her family with the standard cookers available. She inquired at the local S.W. Electricity Board service centre if there was a cooker on the market which she could use by wheeling the front part of the wheelchair underneath it, and thus do her cooking at eye-level.

Mr. Lales-Allen used a standard Jackson 293, a leg model with hob assembly above the oven, and this cooker was cut in half by one of the Board's assemblers. Then the oven and hob were placed side by side on a specially constructed frame, supported by the original legs of the cooker. The original cooker was 20in wide, and the newly-designed model is nearly 3½ft in width. The oven control and wiring were altered, and the framework of the new cooker was made up to the special height requirements of the disabled housewife.

A disabled woman using an electric cooker specially designed for her

I.E.E. Awards

NEW HONORARY MEMBERS : FARADAY MEDAL FOR SWEDISH ENGINEER

THE Council of the Institution of Electrical Engineers has elected **Sir Noel Ashbridge,** B.Sc.(Eng.), M.I.C.E., M.I.E.E., F.K.C., F.I.R.E., a Past-President of the Institution, to honorary membership, in recognition of his distinguished services to the Institution and his outstanding contributions in the field of radio engineering, particularly in the development of the British sound and television broadcasting services. The Council has also elected to honorary membership **Brig.-General Sir Harold Hartley,** G.C.V.O., C.B.E., M.C., M.A., F.R.S., in recognition of his life-long interest in all aspects of engineering science, and for his studies of the conservation of natural resources.

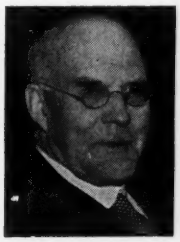
The Council has made the thirty-fifth award of the Faraday Medal to **Dr. Waldemar Borgquist,** lately president of the Swedish State Power Board, for his outstanding contributions to the development of electricity supply and transmission, particularly at extra-high voltages, and for his long-standing interest in the education and training of engineers.

Sir Noel Ashbridge, after six years with Marconi's Wireless Telegraph Co., Ltd., joined the B.B.C. in 1926 as assistant chief engineer, becoming Deputy Director-General in 1943 and Director of Technical Services in 1948. On his retirement from the B.B.C. in 1952 he became a director of Marconi's Wireless Telegraph Co. He was knighted in 1935 and earlier had the knighthood of the Royal Order of Dannebrog conferred on him for his assistance in the setting up of the Danish broadcasting system. He became a member of the I.E.E. in 1933 and was elected President of the Institution in 1941. He has served on numerous committees of the Institution, including the Court of Governors of the Benevolent Fund; in 1948 he presented the Faraday Lecture on "Television."

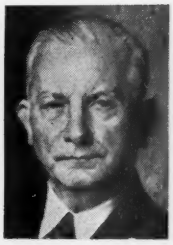
Sir Noel has been chairman of the Radio Research Board and was a member of the Government Television Committees of 1934 and 1943. In 1947 he was elected a vice-president of the Institution of Radio Engineers (America) and in 1949 was president of the Junior Institution of Engineers.

Sir Harold Hartley was appointed chemical adviser to the Third Army, Assistant Director of Gas Services, G.H.Q., France, in the 1914-18 war, and in 1918 became Controller of the Chemical Warfare Department, Ministry of Munitions. He was awarded the Military Cross and was mentioned in despatches three times. His numerous appointments since that time have included those of vice-president and director of research, L.M.S. Railway (1930-45); chairman, Railway Air Services (1934-45); chairman of the Fuel Research Board (1937-47); honorary adviser on development of home-produced fuels, Ministry of Fuel and Power (1939-47); prime warden of the Goldsmiths' Company (1941-42); chairman of the British European Airways Corporation (1946-47); chairman, British Overseas Airways Corporation (1947-49); and chairman, Electricity Supply Research Council of the British Electricity Authority (1949-52). Sir Harold was president of the British Association for the Advancement of Science in 1956, chairman of the World Power Conference from 1935-50, and was president of that Conference from 1950 to 1956. He was president of the Institution of Chemical Engineers in 1951-52 and 1954-55. In 1955 he gave the first Graham Clark Lecture on "The Engineer's Contribution to the Conservation of Natural Resources."

Sir Noel Ashbridge



Sir Harold Hartley



Dr. Waldemar Borgquist

Dr. Borgquist was born at Malmö, Sweden, in 1882. He graduated at the Royal Institute of Technology in Stockholm, in the division of electro-technology, and received further training with the Luth & Roséns Electrical Co., Stockholm, and Siemens-Schuckertwerke, Berlin. In 1908 he was appointed plant engineer at the Trollhättan power station and in 1911 became head of the power station section of the Swedish State Power Board, with which he subsequently held the appointments of chief engineer (1914), director (1919), chief director (1920), and finally director-general and head of the Power Board (1938). He retired in 1947.

Dr. Borgquist was a leader of various commissions between 1911 and 1921. He has been a member of the board of the Luossavaara-Kiirunavaara Ore Co. since 1923, chairman of L. M. Ericsson Co. since 1931, and chairman of the Umeforsen Co. and of the Kattstrupeforsen Co. since 1948. In 1924 he advised the Irish Free State concerning electrification. He is a member of the Swedish Academy of Engineering Sciences, a member of the Physiographical Society in Lund, a member of the Swedish Electro-Technical Committee, chairman of the C.I.G.R.E. National Committee for Sweden, member of the Council of the Swedish Industries' Standardisation Commission, chairman of the Meteorological and Hydrological Council and he is also an honorary vice-president of C.I.G.R.E. Dr. Borgquist has been an outstanding figure in the development of extra-high-voltage a.c. for power transmission and played a major part in inaugurating the work which culminated in the Sweden-Gotland 100 kV d.c. cable. He has always interested himself in the rising generation of engineers and has made it one of his main concerns that they should have adequate facilities for education and training.

Institute of Metal Finishing

The Midland Branch of the Institute of Metal Finishing is organising a competition to encourage younger members to take an interest in productivity in the metal finishing industry. Details will shortly be published and entry forms may be obtained from the offices of the Institute, 32 Great Ormond Street, London, W.C.1. Three main prizes (£30, £20 and £10) will be awarded. Entry is restricted to members who were not more than 35 years of age at 31st December last.

PERSONAL AND SOCIAL

News of Men and Women of the Industry

THE most interesting change in Mr. Macmillan's Cabinet, announced this week, is the alteration of the title of the Minister of Fuel and Power to the Minister of Power, and the appointment of **Sir Percy Mills,** Bt., as the new Minister. Sir Percy, who is raised to the peerage, will be responsible for Government policy in relation to power resources generally. He will assume the existing functions of the Ministry of Fuel and Power in respect of coal, gas, electricity and oil. He will be responsible for extending the use of atomic energy as a source of industrial power. In addition, he will take over from the President of the Board of Trade his responsibilities for iron and steel. Sir Percy has resigned from his many company interests which include the chairmanship of Lancashire Dynamo Holdings, Ltd., and W. & T. Avery, Ltd., and directorships in Babcock & Wilcox, Ltd., and Electric & Musical Industries, Ltd.

Sir Percy Mills

Lord Salisbury, who remains Lord President of the Council, will continue to be responsible for atomic research and development. Other Cabinet changes include the appointments of **Mr. Peter Thorneycroft** (formerly President of the Board of Trade) as Chancellor of the Exchequer, and **Sir David Eccles** (formerly Minister of Education) as President of the Board of Trade. **Mr. Harold Watkinson** is reappointed Minister of Transport and Civil Aviation.

Mr. J. D. Peattie, C.B.E., B.Sc., F.C.G.I., M.I.E.E., acting chief engineer of the Central Electricity Authority, who has been appointed chief engineer retrospectively as from 1st January, 1956, will retire at his own request on 31st January. His services will be retained by the Authority in a consultative capacity. **Mr. F. H. S. Brown,** B.Sc.(Hons.), M.I.Mech.E., M.I.E.E., generation design engineer of the Authority, has been appointed chief engineer as from 1st January in succession to Mr. Peattie. **Mr. E. S. Booth,** M.Eng., M.I.Mech.E., M.I.E.E., generation station construction engineer, has been appointed deputy chief engineer (design and construction) and **Mr. J. C. Duckworth,** B.A., nuclear power engineer, has been appointed deputy chief engineer (nuclear power), both with effect from 1st January.

Mr. J. D. Peattie

Mr. F. H. S. Brown

Mr. Peattie was educated at Morgan Academy, Dundee, and the St. Andrews and London Universities. He spent three years with Siemens-Schuckert, Berlin, and after serving with the Royal Naval Division and the Royal Engineers in the 1914-18 war was engaged successively with Metropolitan-Vickers and Edmiston Brown of Glasgow on heavy plant, factory and mains installation work. In 1925 he joined the Manchester Corporation Electricity Department and was responsible for the change-over from d.c. to a.c. of the low voltage distribution system. In 1928 he was appointed operation engineer, headquarters, Central Electricity Board, of which he became deputy chief engineer in 1944. His first appointment with the Central (then British) Electricity Authority was as deputy chief engineer, and he took over the duties of chief engineer on 1st January, 1956. Mr. Peattie was chairman of the I.E.E. Supply Section for the 1954-55 session.

Mr. Brown, after obtaining a first-class honours degree in electrical engineering at Birmingham University, was for two years a trainee with the Birmingham Corporation Electric Supply Department, and for some five years held appointments as shift charge engineer at the Nechells and Hams Hall power stations. He later returned to these two stations successively as boilerhouse superintendent, having in the interval spent two years in the construction department engaged on the design of Hams Hall "B" power station. In 1946 he joined the West Midlands J.E.A. as assistant construction engineer, and after a year took up an appointment as chief technical engineer with the Liverpool Corporation Electricity Department. On the nationalisation of the electricity supply industry he was appointed generation engineer (construction) of the Merseyside and North Wales Division, B.E.A., and shortly afterwards became chief generation engineer. He was appointed deputy to the generation design engineer at Authority headquarters in 1951 and took up the position of generation design engineer in 1954.

Mr. Booth, after training with Metropolitan-Vickers, joined the staff of the Yorkshire Electric Power Company as an engineer in the station construction department and ultimately became technical assistant to the company's engineer. In 1947, after serving a year as deputy, he became city electrical engineer and manager at Salford. At vesting date Mr. Booth was appointed generation construction engineer of the North Western Division, B.E.A., and two years later joined the headquarters staff as co-ordination engineer (construction), taking up the post he now vacates in 1951.

Mr. Duckworth gained first-class honours in physics and in 1939 joined the Telecommunications Research Establishment, in charge of the division engaged on the design of ground radar stations for the R.A.F. In 1946 he went to Ontario and worked on the Chalk River project. Returning to Britain in 1947, he went to the Atomic Energy Research Establishment at Harwell where he supervised a group working on neutron spectroscopy. He became chief engineer of the Ferranti laboratories, Wythenshawe, in 1950 and in 1954 was appointed nuclear power engineer with the C.E.A.

Mr. E. S. Booth

Mr. J. C. Duckworth

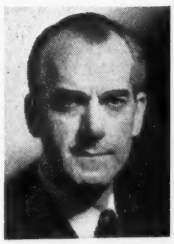
Mr. O. H. Davie, M.I.E.E., who has been with the Cossor group for the past eighteen years, has been appointed to the board of Cossor Instruments, Ltd., as technical director. He contributed to the development of the original Cossor double beam oscillograph and he is the author of a number of patents. Many of his articles have been published in the technical Press.

Mr. O. H. Davie

In the list of electrical men who received awards in the New Year

Honours, published in our issue of 4th January, we should have mentioned **Mr. W. G. Scott,** B.Sc., M.I.Mech.E., M.I.E.E., general manager of the Perak River Hydro-Electric Power Co., who was awarded the C.B.E.

Mr. C. Murray, B.Sc.(Eng.), A.M.I.E.E., has been appointed manager (overseas) of British Insulated Callender's Cables, Ltd. Mr. Murray, who graduated in engineering from University College, London, joined the former British Insulated Cables, Ltd., in 1942, and was later appointed assistant overseas sales manager of that company. In 1950 he became export sales manager (Western Zone) of British Insulated Callender's Cables, Ltd., and two years later was appointed export sales manager. Since January, 1955, he has been deputy overseas manager for Australia, New Zealand and the Americas. Mr. Murray is also a director of British Insulated Callender's (Export), Ltd.



Mr. C. Murray

Laurence, Scott & Electromotors, Ltd., announces that **Mr. J. Wormall,** M.I.E.E., has been appointed industrial sales manager and local director. He will continue to have his headquarters at Openshaw, Manchester. Mr. Wormall received his technical training at Nottingham University and subsequently as a student apprentice with the B.T.H. Co., Ltd., joining Laurence, Scott & Electromotors in 1938. During the last war he served with the R.E.M.E., attaining the rank of lieut.-colonel.

Mr. J. Wormall

Mr. D. N. de Mattos, B.Sc.(Eng.), A.M.I.E.E., Grad.I.Mech.E., has been appointed manager of the Bristol and South West district office of the British Thomson-Houston Co., Ltd. Previously this office, of which he has been resident sub-manager for the last two years, formed part of the London office territory.

Mr. D. N. de Mattos

Mr. de Mattos was educated at Christ's Hospital, Horsham, before joining the B.T.H. Co. in 1940 as an engineer apprentice. Two years later he left to study full time at Northampton Engineering College, London. During the war he was in the R.N.V.R., serving mainly in the Far East. In 1947 Mr. de Mattos rejoined the B.T.H. Co. as a graduate apprentice and in 1950 he was posted to the staff of the company's Manchester district office and two years later transferred to the London district office where he remained until his appointment to Bristol in 1954.

Mr. R. R. Whyte, M.B.E., B.Sc. (Eng.), has been appointed assistant works manager (mechanical) of the Metropolitan-Vickers Electrical Co., Ltd., and in this capacity will be responsible for the Large and Small Turbine Departments and the company's Germiston Works (Glasgow). Mr. A. Paterson's position as assistant works manager, Trafford Park Works, remains unaltered. Educated at University College School and City and Guilds Engineering College, London, and at Freiburg University, Mr. Whyte joined M-V as a college apprentice in 1933. After six months' extended apprenticeship at the Prague Works of the C.K.D. he joined the Turbine Experimental Department at Trafford Park, and two years later transferred to the Steam Turbine Manufacturing Department. In 1944 he became assistant superintendent, Mechanical Department, but later that year transferred to take charge of manufacture at the M-V gas turbine factory at Barton and in 1949 was appointed superintendent of the Gas Turbine Department (later Small Turbine Department). In 1954 the responsibility for the company's Germiston Works in Glasgow, manufacturing steam turbine condensers and associated auxiliaries, was added.

Mr. R. R. Whyte

The Minister of Fuel and Power has appointed **Mr. John Ryan,** C.B.E., M.C., M.A.(Cantab.), B.Sc., of Ealing, Middx., as a part-time member of the Southern Electricity Board with effect from 1st January. The Minister has reappointed **Mr. W. H. Lawson,** C.B.E., B.A., F.C.A., of Chobham, Surrey, and **Lt.-Col. E. L. Luce,** D.S.O., T.D., J.P., of Warminster, Wiltshire, as part-time members of the Board.

Mr. Miles Beevor, deputy chairman and joint managing director of the Brush Group, Ltd., has relinquished the post of joint managing director. He remains as deputy chairman. **Mr. Ian T. Morrow,** joint managing director, has been appointed managing director. **Mr. Charles Barnard,** hitherto managing director of Mirrlees, Bickerton & Day, Ltd., has been appointed to the board of the Brush Group, Ltd., with special responsibilities for the group's heavy engine factories (Mirrlees, Bickerton & Day, Ltd., the National Gas & Oil Engine Co., Ltd., and J. & H. McLaren, Ltd.). **Mr. M. C. Clear** has also been appointed to the board of the Brush Group, Ltd., as director in charge of exports.

Mr. R. T. de Poix has been elected chairman of the Zinc Development Association for 1957. Mr. de Poix is the managing director of Henry Gardner & Co., Ltd., and represents the Canadian zinc producers, the Consolidated Mining & Smelting Co. of Canada, Ltd., and the Hudson Bay Mining & Smelting Co., Ltd., on the Council of the Association.

Dr. Eni Njoku, lecturer at University College, Ibadan, has been appointed chairman of the Electricity Corporation of Nigeria.

Mr. H. H. Saint has recently been appointed chief sales engineer for the Electrical Division of the Expanded Metal Co., Ltd., which covers also the products of its subsidiary, the Cressall Manufacturing Co., Ltd. Mr. Saint has been associated with the design, manufacture and sales of electrical resistors and heaters since 1930, covering a wide range of such equipment for industrial, traction and marine applications. He joined the Expanded Metal Co. in 1945.

Mr. H. H. Saint

To mark their appreciation of his services to the B.E.A.M.A. Publicity Committee, a presentation was made by its members to **Mr. E. E. Walker,**

Mr. E. E. Walker (left) receiving the presentation from Mr. C. H. Alsop, chairman of the B.E.A.M.A. Publicity Committee

F.I.A.M.A., publicity manager of the Metropolitan-Vickers Electrical Co., Ltd., at a luncheon on 8th January, on the occasion of his retirement which was reported in our issue of 14th December.

Mr. V. S. Risoe, M.B.E., was appointed to the board of Associated Electrical Industries Overseas, Ltd., last month and has resigned from the boards of Associated Electrical Industries (India) Private, Ltd., and Associated Electrical Industries Manufacturing Co. Private, Ltd. After taking his engineering degree at University College, London, in 1933, Mr. Risoe went to Malaya on outside construction work for a year and then began his student apprenticeship with the British Thomson-Houston Co., Ltd., Rugby. He joined the commercial staff of the B.T.H. Co. in 1937 and was posted to the Madras office of A.E.I. (India) in 1939. He was later seconded to the Supply Department of the Government of India and, in 1942, was appointed Director of Electrical Engineering. On returning to A.E.I. (India), Ltd., in 1946 he was appointed manager of the Calcutta office. He was appointed to the board of A.E.I. (India), Ltd., in 1949 and to the board of Associated Electrical Industries Manufacturing, Ltd., in 1952. While in Calcutta Mr. Risoe was chairman of the India Committee of B.E.A.M.A. for two years, and was also chairman of the Calcutta Branch of the Institution of Electrical Engineers for a similar period.

Mr. V. S. Risoe

In our last issue we reported the resignation of **Mr. E. Bruce Ball** from the board of Metal Industries, Ltd., and also from the boards of all subsidiary companies. In a circular to shareholders the company states that following the extraordinary meeting held on 20th December, **Sir J. Donald Pollock,** Bt., **Mr. S. J. L. Hardie** and **Mr. R. W. McCrone** have resigned from the offices of hon. presidents of the company. The appointment of **Dr. W. H. Garrett** as an additional director has now been regularised.

Mr. R. F. Mayne has retired from the Micanite & Insulators Co., Ltd., after forty years' service in the Mica Department, of which he was manager for thirty-four years. He is succeeded by **Mr. A. W. Townsend,** who has been his assistant for twenty-six years. To mark the occasion presentations were made to Mr. Mayne of a cheque from the directors (presented by Mr. H. A. Cooper, director and joint general manager), a fishing rod from the M. & I. Foremen's Association (presented by Mr. D. J. Greene, president) and a convector heater from the M. & I. Long-Service Association (presented by Mr. S. W. Messent, vice-chairman of the Association). Mr. Mayne served for many years on the Management Committee of the Mica Trade Association.

Mr. W. I. Pumphrey, Ph.D., M.Sc., research manager of Murex Welding Processes, Ltd., has been awarded the degree of D.Sc. in industrial metallurgy by the University of Birmingham for his work on hardenability, the transformation of steel during continuous cooling and the metallurgy of welding. Dr. Pumphrey is a member of a number of scientific and technical societies and is the author of many papers on metallurgical subjects.

Dr. Mahmoud Hessaby, Dean of the Faculty of Science in Teheran University and a senator of the Iranian Parliament, is visiting the United Kingdom during the first three weeks of January, under the auspices of the British Council. It is proposed to set up an atomic research centre in his university and the object of Dr. Hessaby's visit is to study British experience in this field and to inspect British equipment. His programme in Britain has included visits to Oxford, Cambridge and Manchester universities, Queen Mary College, London, the National Physical Laboratory, the Atomic Energy Research Establishment, Harwell, and Calder Hall. He is visiting a number of companies and the Scientific Instrument Manufacturers' Association.

Mr. H. Mounsten-Harrison, chief electrical engineer to the Yorkshire Copper Works Co., Ltd., has been appointed divisional chief electrical engineer to the Port of London Authority.

Mr. L. C. Jesty, B.Sc., M.I.E.E., has joined the Sylvania-Thorn Colour Television Laboratories, Ltd., Enfield, Middx., where he will be in charge of colour T.V. research.

Mr. L. C. Jesty

Mr. Jesty, who since 1949 has been chief of the television research group at the Marconi Research Laboratories, graduated from University College, Southampton, and was appointed to the staff of the G.E.C. Research Laboratories at Wembley in 1927, being engaged for some time in research on electric lamps. In 1933, however, he started and built up a cathode ray tube research group. He commenced specialist work on radar applications of cathode ray tubes in 1938 and in 1944 he was promoted to the leading scientific staff of the Laboratories. In 1946 Mr. Jesty demonstrated at the Physical Society Exhibition the electronic control of colour picture reproduction by means of a field-sequential flying-spot colour television film scanner. From 1946 to 1949 he was head of advanced research at the Cinema-Television Laboratories. Here he worked on many aspects of the application of television to the film industry. Mr. Jesty was elected a Fellow of the Institute of Radio Engineers, New York, last year.

The annual apprentice prize-giving of **George Kent, Ltd.,** was held at Luton on 7th January. The guest speaker was Sir John Burgoyne, O.B.E., J.P., and the prizes were presented by Commander P. W. Kent, R.N. (Retd.) (chairman and managing director). An exhibition of apprentices' work, including hobbies, was held in conjunction with the prize-giving.

Mr. F. E. Fry, who has been with Gent & Co., Ltd., for thirty-five years as a technical representative, retired on 31st December. He is a past-president of the Leicester Branch of the United Kingdom Commercial Travellers' Association.

Mr. F. E. Fry

Mr. R. R. Stokes, M.P. for Ipswich, chairman and managing director of Ransomes & Rapier, Ltd., and managing director of Cochran & Co. (Annan), Ltd., left this week on a short visit to Beirut and Baghdad.

The ninth annual dinner of the Technical and College Apprentices' Association at the Trafford Park Works of **Lancashire Dynamo & Crypto, Ltd.,** was held on 5th January. Mr. A. W. A. Dick-Cleland (joint managing director) and Mrs. Dick-Cleland, together with executives of the company and their wives, attended the function. The principal guest was Dr. J. R. Whittaker, of Dundee Technical College, who replied to the toast of the guests. The awards were presented by Mrs. J. R. Whittaker and the principal presentations were made to Mr. A. Clegg, the best "all round" apprentice, who received the "D.C." Cup, and Mr. R. Tonge, the best pass in the Ordinary National Certificate examination, who received the Abbey Trophy.

At the recent Christmas party of Courtney, Pope (Electrical), Ltd., Mr. A. H. Olson, B.Sc., M.I.E.E., managing director, presented a gold watch to **Mr. E. F. Cooper,** the chief draughtsman of the company. Mr. Cooper was recently awarded the Albert Brammer trophy and the Association of Supervising Electrical Engineers' Exhibition Monetary Award for attaining the standard set by its Committee; he has

also passed the examination for the A.S.E.E. technician's certificate in the layout and design section.

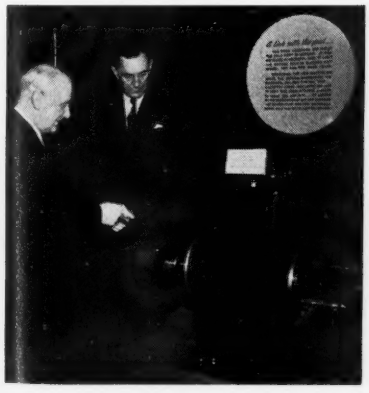
Mr. H. B. Scaife retired on 31st December after over thirty-four years' continuous service with the B.T.H. Co. and the newly formed A.E.I. Lamp & Lighting Co., Ltd. He joined the B.T.H. Sheffield office Lamp and Wiring Supplies Department in 1922 as managing clerk, taking over the Sheffield area as salesman in 1929. He became manager of the Hull depot in 1940 where he remained until his retirement.

F. Westerman (Wholesale), Ltd., held their annual staff dinner on 5th January, at the Grand Hotel, Birmingham. Mrs. Westerman presented the "Welec" Social Club's snooker cup to the winner, Mr. H. E. Bagnall, the company's secretary, and three Smiths clocks to other members of the staff for long service with the company. Mr. F. Westerman, proposing a toast to the staff, said that, due to their efforts, the company had had a good year. Mr. D. A. Ray, the company's representative for Warwickshire and Oxfordshire, proposed the toast to the company. Mr. H. E. Bagnall proposed the toast to the visitors and Mr. A. H. Adey, Ediswan Birmingham branch manager, responded. Other guests were Mr. G. Palfreman (Bill Switchgear, Ltd.), Mr. W. Parker (Monmore Conduits, Ltd.), and Mr. R. Voaden (A.E.I. Lamp & Lighting Co., Ltd.).

Mr. John Oldham, O.B.E., chairman and joint managing director of Oldham & Son, Ltd., has left for a two months' visit to the company's subsidiaries in South and Central Africa.

Mr. A. C. Parker, M.Inst.F., who recently resigned from the sales staff of Davey, Paxman & Co., Ltd., has been appointed commercial manager of the Bennett group of companies.

At the "Electricity from Atoms" Exhibition in Glasgow a generator constructed by Col. Crompton was presented to Mr. J. B. Scott, sales director of Crompton Parkinson, Ltd., for the company's collection of historic equipment. In the photograph Mr. J. S. Pickles, chairman of the South of Scotland Board, who made the presentation, is seen with Mr. Scott (right)



Mr. E. Hartles has been appointed commercial director and **Mr. H. F. James,** B.Sc., technical director of McKechnie Brothers, Ltd.

Mr. B. G. Lund, E.R.D., A.M.I.E.E., A.M.I.Mech.E., has joined Maurice G. Bland & Son, consulting engineers, as a partner.

Mr. P. J. Cooper, A.M.I.E.E., has been appointed group electrical engineer of John Thompson, Ltd., Wolverhampton, as from 1st February. Mr. Cooper received his training with Laurence, Scott & Electromotors, Ltd., at Norwich, following which he spent two years with Royal Mail Lines, Ltd., as electrical engineer officer on board R.M.S. *Andes* and *Almanzora* and M.V. *Pardo*. After two years in the Switchgear Department of the English Electric Co., Ltd., at its Stafford works, Mr. Cooper was transferred to the company's Wolverhampton office as technical sales engineer, a position he has held for the past six years.

Mr. P. J. Cooper

Mr. D. Strachan, London office manager, wire division, with the Spencer Wire Co., Ltd., Wakefield, retired on 31st December. He had been with the company for twenty-five years.

Mr. W. Pitkethly has been appointed manager of the Purchases and Supplies Department of the British Aluminium Co., Ltd., with effect from 2nd February, in succession to **Mr. R. L. C. McDonald,** who retires from the company's service on that date.

The annual New Year party and ball of **Marconi Instruments Social and Sports Club,** St. Albans, was held in Watford Town Hall on 4th January. Some 750 members and friends attended and games and competitions added to the gaiety of the evening. Mr. R. E. Burnett, general manager of Marconi Instruments, Ltd., congratulated the Club on its efforts.

The annual dinner of the **Ipswich and District Electrical Association** will be held on 15th February at the Great White Horse Hotel, Ipswich.

OBITUARY

Mr. L. E. Mold, O.B.E., M.I.E.E., late director of A. Reyrolle & Co., Ltd., died on 10th January at the age of sixty-seven. Mr. Mold served four years' pupilship with the Oxford Electricity Co., Ltd., before joining the Newcastle-upon-Tyne Electric Supply Co. as a junior engineer. In 1912 he joined A. Reyrolle & Co. as a sales engineer and was responsible for a number of their earlier major power station contracts, including Sheffield and Birmingham. Mr. Mold served in the Royal Engineers during the 1914-18 war, attaining the rank of major as Deputy Director of Army Signals. For his work in France he was awarded one of the first military O.B.E.s, and was four times mentioned in despatches. He returned to Hebburn in 1919, and after a short time with the British Thomson-Houston Co., Ltd., at Rugby, he rejoined A. Reyrolle in 1922 as assistant to the late Mr. H. W. Clothier, with whom he was closely associated in the development of metalclad switchgear and the extension of its use at home and overseas. He was appointed sales manager in 1929 and a director of the company in 1937, in which capacity he served until his retirement in 1954. Mr. Mold was also a director of C. A. Parsons & Co., Ltd., a past chairman of the North Eastern Centre of the Institution of Electrical Engineers, and, for a number of years, a member of the B.E.A.M.A. Council.

Mrs. Mary Frances Ratcliffe, wife of Mr. J. Ratcliffe, A.M.I.E.E., died on 22nd December. Mr. Ratcliffe, who is now with the North Western Electricity Board, was formerly engineer and manager of the Birkdale and the Dunoon Supply Co. undertakings, and engineer and manager of the local authority undertakings of the Whitworth, and the Bredbury and Romiley Councils.

Mr. Albert Edward Sudlow, founder of the Manchester electrical contracting company, Albert E. Sudlow & Co., Ltd., and a member of the Electrical Contractors' Association, died on 11th January at the age of seventy-seven.

Mr. A. F. Hopkinson.—The death has occurred of Mr. Alec F. Hopkinson, technical engineer attached to the London office of Hopkinsons, Ltd.

Dame Caroline Haslett.—A memorial service for the late Dame Caroline Haslett will be held on Friday, 25th January (12 noon) at St. Martin-in-the-Fields, London.

WILLS

Mr. G. W. Spencer Hawes, O.B.E., M.I.E.E., a former chairman of the Electric Construction Co., Ltd., who died on 13th October, left £44,828 gross (£44,655 net).

Mr. H. G. Baggs, formerly chairman of Dorman & Smith, Ltd., who died on 29th September last, left £31,301 gross (£31,138 net).

Mr. H. N. Booth, principal of Booth and Son, Oldham, dealers in electrical fittings, who died on 4th August, left £12,511 gross (£12,183 net).

Mr. L. S. Funnell, a former managing director and secretary of Bullers, Ltd., who died on 5th August, left £54,765 gross (£54,335 net).

Mr. J. Henderson, A.M.I.E.E., power cables engineer to British Insulated Callender's Cables, Ltd., who died on 21st October last, intestate, left £4,049 gross (£3,983 net).

Mr. R. A. Parsons, A.M.I.E.E., director of Parsons of Gloucester, Ltd., who died on 20th September last, left £5,308 gross (£5,244 net).

INDUSTRIAL NEWS

Position of the B.I.F.

Mr. E. M. Clayson, chairman of the executive committee of the British Industries Fair, Birmingham, said last week that the prospects of this year's display (6th to 17th May) had been adversely affected by petrol rationing. Not many firms which had previously exhibited in London had booked space at Castle Bromwich. Of former Birmingham exhibitors only 53 per cent had taken space for the 1957 Fair; last year at the same time over 65 per cent had come in.

In reply to a question Mr. Clayson said that there was a possibility of "internationalising" the Fair if the United Kingdom became linked with a European free trade area.

Wiring Rules Interpretations

Interpretations of the Regulations for the Electrical Equipment of Buildings, issued by the Institution of Electrical Engineers in September last, have been published in the form of a loose-leaf booklet by the Electrical Contractors' Association, 14, Bedford Row, London, W.C.1. Copies are obtainable at 2s each.

Engineering Wage Claim

Practically without debate delegates from the engineering unions meeting at York on 10th January decided to re-approach the employers' organisation with their claim for a 10 per cent increase in wages. The executive committee of the Confederation of Shipbuilding and Engineering Unions was empowered to tell the employers that if a satisfactory agreement could not be reached action would be taken to enforce the claim.

Installation Workers' Strike

Over 100 employees of the Southern Electricity Board at Reading engaged on installation work, maintenance, etc., went on strike last week and are demanding an independent inquiry into the efficiency of the wiring department. They are also seeking the reinstatement of Mr. E. Jones, installations engineer, who, they say, was given notice after protesting against the dismissal of ten men on grounds of redundancy.

The Board later stated that the decision to dispense with Mr. Jones's services was unconnected with any representations he had made regarding redundancy of employees in the contracting section, which occurred six months ago. The strike was in breach of the agreement with the unions governing terms and conditions of employment, and was against the advice of the principal union concerned.

On Monday it was reported that the men had decided to stay out until their demand for an inquiry had been met. The matter was to be considered yesterday (Thursday) by the National Joint Industrial Council.

Factory Floor Warming Installation

An extensive scheme of electric floor warming is being installed in the new Hemel Hempstead factory of Base Metals, Ltd., by the Eastern Electricity Board. The work is being executed in "Pyrotenax" copper sheathed mineral insulated cable laid direct on to the oversite concrete, the final screed being of granolithic finish for durability and cleanliness. In one section of the factory where a barium plant will be in operation the "Pyrotenax" cable will be a special p.v.c. type for protection purposes.

The installation has been designed to maintain comfortable working conditions in all parts of the factory and will be controlled automatically by anticipatory temperature control gear. In order to obtain the desired results the temperatures will vary in different parts of the factory. In the kitchen, for instance, 55 deg F is sufficient but in the electrical laboratory, in the office and in the conference room 65 deg is necessary, while 60 deg is enough in the workshop, the store and the canteen.

The total floor warming load will be 155·9 kW and the spacing of the cable will vary from 4¼ to 6½in. In addition eleven thermal storage heaters will be installed.

Milk Roundsman's Death

The resumed inquest was held in Leeds on 10th January on Albert Sames (52), a milk roundsman with Leeds Industrial Co-operative Society, who was trapped beneath his 24 V powered hand-operated milk truck on 26th December. A window cleaner said he heard a shout for help and saw Sames's legs protruding from underneath the milk truck. When another man arrived they were able to release Sames, who was found to be dead on arrival at Leeds Infirmary.

Dr. H. Thompson, pathologist at Leeds University, attributed death to electrocution. He said that marks on the dead man's right hip and on the upper part of his back were almost certainly caused by electric current entering and leaving the body. He added that 25 V had been known to be fatal, but the most important factor in a case of electrocution was the amperage.

Mr. G. A. Farthing, A.M.I.E.E., who examined the electrical gear of the milk truck, found all parts in good order, except for a slight leakage of acid damp on to the battery case, but said that that was not likely to cause danger.

The Coroner (Mr. R. E. Nutt) told the jury: "You may think it possible that this man lost his footing in the slushy snow and fell and the vehicle passed over him. The electricity that killed him could only have come from this machine in spite of the fact that no satisfactory explanation has been put forward as to how it occurred." The jury found that Sames had been "electrocuted" by his truck and returned a verdict of "Accidental death."

Domestic Heating Conference

Volume 2 of the transactions at the conference on domestic heating, which was arranged last May by the Institute of Fuel (see *Electrical Review*, 4th and 11th May, 1956), is now available. Its contents include reports of the discussions of the 45 papers submitted and the text of some of the papers that were received too late for publication in Vol. 1, which was issued in advance of the conference. The two volumes can be obtained from the Institute of Fuel, 18, Devonshire Street, London, W.1, at 32s 9d, post free. Additional copies of Vol. 1 can be supplied at 22s, post free.

Prices of Materials

In the accompanying table we give the basis prices of the more important materials used in the electrical industry. The figures given are the selling prices and are those quoted on Tuesday last.

ALUMINIUM ingots	ton £197 0s 0d
COPPER, H.C. Electro	ton £270 15s 0d
Fire Refined 99·70%	ton £269 0s 0d
Fire Refined 99·50%	ton £268 0s 0d
COPPER Tubes ..	lb 2s 6⅞d
Sheet	ton £299 5s 0d
H.C. wire and strip ..	ton £316 15s 0d
LEAD, English ..	ton £116 15s 0d
Foreign	ton £115 0s 0d
MERCURY	flask £84 15s 0d
TIN, block (English) ..	ton £783 0s 0d
ZINC, G.O.B. Foreign	ton £103 5s 0d
Electrolytic	ton —
BRASS Tubes (solid drawn)	lb 2s 1¾d
Sheet	ton —
Wire	lb 2s 10⅜d
PHOSPHOR BRONZE Wire	lb 4s 3¾d
PLATINUM	oz £34 0s 0d
RUBBER, No. 1 R.S.S. spot	lb 28½d-28¾d

Contract Price Formulæ

The British Electrical and Allied Manufacturers' Association has issued the figures for its contract price adjustment formulæ. In each case the rate of pay for adult male labour at 12th January is deemed to be 175s.

The "cost of materials" figures are: For electrical machinery and equip-

ment the Board of Trade index figure published on 12th January is 187·8. For turbo-generating and allied plant: Materials used in mechanical engineering industries, 181·0, blast furnaces and iron and steel melting and rolling (40 and 41), 172·1. The price of ¾in o/d 18 s.w.g. brass condenser tubes (*Metal Bulletin*, 11th January) is 48⅞d per lb.

Northern Rhodesian Copper

Speaking at an informal meeting of shareholders of the Rhodesian Selection Trust, Ltd., and Roan Antelope Copper Mines, Ltd., in London on 10th January, Sir Ronald Prain, O.B.E., chairman, referred to the supply of power to the Northern Rhodesian Copperbelt. He said that for the first time since the war there had been no power problems. The introduction of hydro-electric power from the Belgian Congo had became fully effective and with this power and through the use of Wankie coal for their thermal power stations they should be able to do away with wood and oil burning and stop the importation of expensive foreign coal.

It was hoped that this situation would continue for two or three years, by which time a supply of power should be available from the Kariba hydro-electric plant. For a time it might be "touch and go," depending on the exact date of commissioning of the first set at Kariba and hydrological conditions in the Belgian Congo. The matter was under review by the Rhodesian Congo Border Power Corporation, jointly owned by the copper companies in the region.

After referring to the virtual doubling of freight charges by the Rhodesia Railways, Sir Ronald Prain said that supplies of copper were now adequate to meet present demands. They could not look for any appreciable reduction in costs.

The group's price-stabilising policy had been adopted in response to representations from the British Non-ferrous Metals Federation. Their production represented only about 7 per cent of world production so that they could not bring about any major change on a world basis. But the step which they had taken represented a sincere attempt to bring about an improved state of affairs. They realised that the existence side by side of two pricing systems had created problems for the United Kingdom industry but the solution must depend on co-operation and consent by consumers and other producers; it was not a problem which their group could solve unilaterally.

Electric Tool Repair Workshop

Wolf Electric Tools, Ltd., has moved its head Service Department from 239, Acton Lane, London, W.4, to larger premises in Shepherd's Bush, London, W.12. The department, controlled by Mr. C. S. Butcher, general service manager, consists of a new two-storey office block together with separate repair workshops in which modern repair equipment is installed. Tools in need of service should be addressed to Wolf Electric Tools, Ltd., Head Service Department, Newlon Works, off Stanlake Villas, Stanlake Road, Shepherd's Bush, London, W.12 (telephone: Shepherd's Bush 4414/5/6). In addition to service, a comprehensive stock of spare parts is also maintained.

Part of the new repair shop of Wolf Electric Tools, Ltd.

St. Lawrence Project Tenders

A *Reuter* message from New York states that the New York State Power Authority announced on 8th January that the English Electric Co., Ltd., was the apparent lowest bidder for a three-phase auto-transformer for the St. Lawrence Seaway project. Bids were received from the English Electric Co. and American and Italian companies. They will be studied by the Authority's engineers before a contract is awarded. The British tender was $415,854 (about £150,000).

Unauthorised Export of Alloy

At the Central Criminal Court last week the Tetra Engineering Co., Ltd., of Redhill Street, London, N.W., Karl Felix Mayer, company director, of Elm Bank, Walton Lane, Shepperton, and David Brooks, engineer, of Thorny Pits Hostel, Hawthorne, Chippenham, were fined a total of £4,575 on charges concerned with the export to Hungary, without a licence issued by the Board of Trade, of a superfine alloy (Vacon) used in the manufacture of electric lamps, radio valves and X-ray tubes.

It was stated that the alloy was ordered from Western Germany for import into the United Kingdom but instead was diverted to Hungary. The company, which had pleaded guilty to three charges, was fined £3,000, with 250 guineas costs, and Mayer and Brooks, who pleaded guilty to counselling and procuring the company to commit the offences, were fined £1,500 and £75, respectively.

The Common Serjeant said he was asked to believe that the regulations were not properly understood and was prepared to give the benefit of any doubt upon that issue. He fixed the alternative to the fines at twelve months' imprisonment in the case of Mayer and three months' in the case of Brooks.

Approving Equipment for Canada

The approvals agency operated by the British Standards Institution on behalf of the Canadian Standards Association has recently put through the thousandth application for approval of electrical equipment since its inception seven years ago. The application was made with a strong backing from the office of the Canadian Commissioner in London, and was specially handled by the staff of the B.S.I. Agency. By using the full resources of the airmail and trans-atlantic telephone services the agency's report on the factory and products concerned was transmitted to Toronto and the C.S.A. confirmation of approval was back in this country within one week from the application having first been made.

Not every application could be dealt with in such a short space of time; the goods concerned in this instance were of a fairly simple technical nature (convector heaters), but if manufacturers provide the necessary information and facilities without delay, approvals can always be completed within a reasonable period. Much delay derives from the failure of many manufacturers to realise that their products actually require C.S.A. approval before being exported to Canada.

Stud Welding Competition

Crompton Parkinson, Ltd., announce details of an annual international award for the year's most outstanding contribution in the field of semi-automatic electric arc stud welding, having the effect of reducing manufacturing costs, improving the appearance, serviceability and life of a product or structure, or performing a function not possible by any other

method. The principal award is $1,500 in cash or $2,000 in scholarships for any individual or school of the winner's choice.

A supplementary award comprising a complete stud welding equipment will be presented to the engineering school or college whose students and faculty shall have submitted the most outstanding group of entries in this competition. Additional equipment awards to educational institutions will be made on the recommendation of the judges if warranted by the calibre and/or number of entries.

Gregory Industries, Inc., Lorain, Ohio, who are licence associates of Crompton Parkinson, Ltd., are sponsors of the competition, and the awards will be presented at the 1957 awards luncheon of the American Society for Metals, in Chicago on 5th November next. Entries will be judged by a committee under the chairmanship of Dr. Donald S. Clark, president of the American Society for Metals. Residents of the United States, Canada and all other countries where the Nelson stud welding process is currently in use are eligible for the award. Individuals in any way associated with the manufacture, sale or distribution of stud welding equipment are not eligible for this competition. Entry forms and rules may be obtained from Crompton Parkinson, Ltd., Stud Welding Organisation, 1-3, Brixton Road, London, S.W.9.

Instrument Exhibition

The third international instrument show, sponsored by B. & K. Laboratories, Ltd., and Allied International Co., Ltd., is being held at Caxton Hall, Westminster, London, S.W.1, from 25th to 29th March inclusive. Over fifty instrument manufacturers from the United States, Switzerland, Western Germany, Denmark, Holland, Sweden, Austria and Great Britain will be displaying some three hundred items of test equipment and apparatus, a number of which will be demonstrated in typical applications. Tickets are obtainable from B. & K. Laboratories, Ltd., 57, Union Street, London, S.E.1 (telephone: Hop 4567).

P.O.A. Report

The annual business report of the Economic Survey Committee of the Purchasing Officers' Association reviews business conditions in the various industries during 1956. Dealing with the electrical engineering industry, it states that reports indicate that order book levels for medium and heavy equipment have remained fairly static over the year. In light electrical engineering, concerns have experienced fluctuating fortunes, order book levels at the end of 1956, as compared with a year ago, varying from "lower" to an improvement of up to 25 per cent for home and 10 per cent for export. Production levels show a similar movement over the year's working. The position in the supply of materials is dealt with, the materials which are in short supply are enumerated, and the rise in the price of certain commodities is referred to.

National Union of Manufacturers

Three years ago the National Union of Manufacturers set up, with the help of counterpart funds, an industrial advisory service. The demand on this service has increased rapidly and to provide an organisation better equipped to deal with it, the N.U.M. has now set up a new non-profit-making company, the National Union of Manufacturers' Advisory Service, Ltd., to be known as N.U.M.A.S., which is already operating from its own office at 45-46, St. Paul's Churchyard, London, E.C.1 (telephone: City 2135/6). The chairman of the new company is Mr. G. Salter, chairman of the Midland Council of the N.U.M., and the managing director is Mr. G. L. Page. The N.U.M.A.S. senior staff of industrial advisers are prepared to visit any firm, irrespective of size, to discuss and report on such matters as organisation structure, finance, marketing and distribution, management, accountancy, materials control and production.

Trade Announcements

The Dubilier Condenser Co. (1925), Ltd., has appointed Wm. Don, Ltd., Crown Works, Crown Point Bridge, Leeds, 9 (telephone: 33781-2) as its selling agents in the counties of Yorkshire, Durham and Northumberland for the sale of power factor correction capacitors.

The Belfast branch office of **Honeywell-Brown, Ltd.,** has moved to larger premises at 296, Albert Bridge Road, Belfast.

American Courts and Restrictive Agreements

An account is given in *Anglo-American News* (the journal of the American Chamber of Commerce in London) of the proceedings in United States Courts in an action taken against Holophane Co., Inc., manufacturers of prismatic glassware, alleging violation of the Sherman Act.

The cause of action was an agreement made when the American business was sold to the defendant company by its British "parent," Holophane, Ltd., in 1925. This agreement provided that neither company would export into the territory of the other—the areas being specified—and the parties also agreed not to apply for patent or trade mark protection in each other's territories, and to assign to each other inventions, designs, discoveries, improvements and trade marks. A similar agreement was made with the French Holophane company.

The District Court in Ohio found that there had been a violation of the Sherman Act which forbade the conclusion of agreements in restraint of trade or commerce with foreign nations. It ordered the cancellation of the agreements and this judgment was subsequently confirmed by the Supreme Court.

On one paragraph of the District Court's decree the Supreme Court was equally divided but this did not affect the confirmation of the original judgment. This paragraph (XI) directed the Holophane Co., Inc., to use reasonable efforts to promote the sale and distribution of its products in foreign markets, including the territories of the British and French companies, upon terms and conditions of sale not discriminatory as compared to those offered to purchasers in the United States.

It further stipulated specific steps to be taken to promote and develop export sales. The company was to circularise potential distributors in the British and French companies' territories; to advertise at reasonable intervals over a period of five years in all countries in which the products of the British and French companies were sold in substantial quantities; and to take certain other steps. The company was to file a report with the District Court annually for five years showing what action had been taken under Paragraph XI.

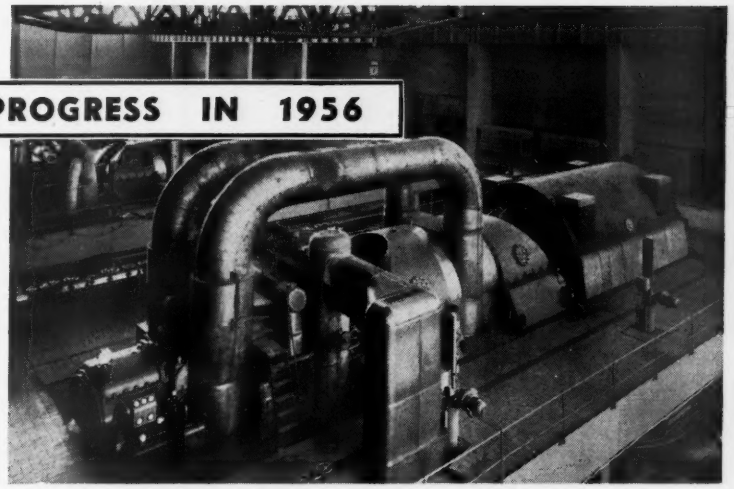
The *Anglo-American News* points out that these extraordinary provisions "raise grave questions of country and international law." But much of the sting has been taken out of the decree by statements made in the Government's brief, in the argument before the Supreme Court and in a letter sent to the clerk of the Court by the Solicitor-General. The Government lawyers advised the Court that they construed the provision requiring Holophane to use "reasonable efforts" to sell its products in foreign markets only required efforts that would not involve violation of any foreign law or the valid judgment of any foreign court. Nor did the decree require Holophane to perform any acts abroad which a foreign court might prohibit.

It is rightly pointed out by the *Anglo-American News* that although the Solicitor-General has said that the District Court's decree might properly be interpreted as not requiring the company to take any action "which is clearly precluded by the exercise of sound business judgment, formulated without regard to the prior unlawful restraints of trade," the company "will have a difficult tight-rope to walk."

The account concludes:—"The broader question of the extent to which American courts may properly go in ordering American companies to compete in foreign markets is yet to be determined. . . . It is hoped that another opportunity will be given the Court to clarify this important issue."

MANUFACTURING PROGRESS IN 1956

The British Thomson-Houston Co., Ltd.



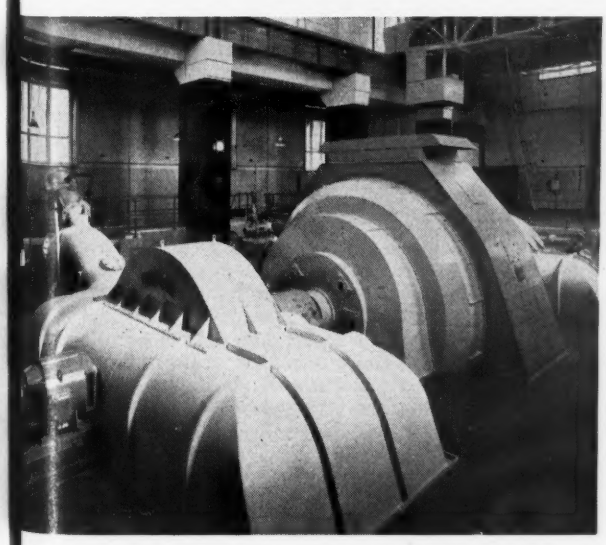
The second 60 MW turbo-alternator was installed last year at Meaford "B" generating station

DURING the past year many important installations of power plant manufactured by the British Thomson-Houston Co., Ltd., have been completed or have reached an advanced stage of erection in various parts of the world, notable among these being hydro-electric generators in New Zealand, Norway, Scotland, and Uganda, and many high-voltage oil circuit-breakers and transformers have been installed overseas as well as at home on the Central Electricity Authority's high-voltage and super-grid networks. The contract for the nuclear power station at Berkeley, Glos, has been placed with the A.E.I.-John Thompson Nuclear Energy Co., Ltd., the associated civil contractors being Balfour, Beatty & Co., Ltd., and John Laing & Son, Ltd. This project will cost £30 to £40 million.

The main turbine factory at Larne was taken over from the contractors in November, and a large part of it is expected to be ready for operation early in the New Year. The blading factory, which started production in 1955, has been building up its output.

Turning to general turbine business, a further order has been received for two 11 MW machines for the Wairakei geothermal power station in New Zealand. These are designed for steam at 51 lb/sq in gauge and exhaust to a back-pressure of 16 lb/sq in abs. Other orders include the eighth 15 MW set for Ahmedabad power station, in which twelve B.T.H. machines are already installed; a 1,500 kW set for the Indian Aluminium Co.; and a 750 kW unit for Gray's Inn (Jamaica) Central Factory, Ltd.

This 35,294 kVA horizontal hydro-electric generator at Finlarig power station is the largest machine of its kind installed in 1956 in Great Britain

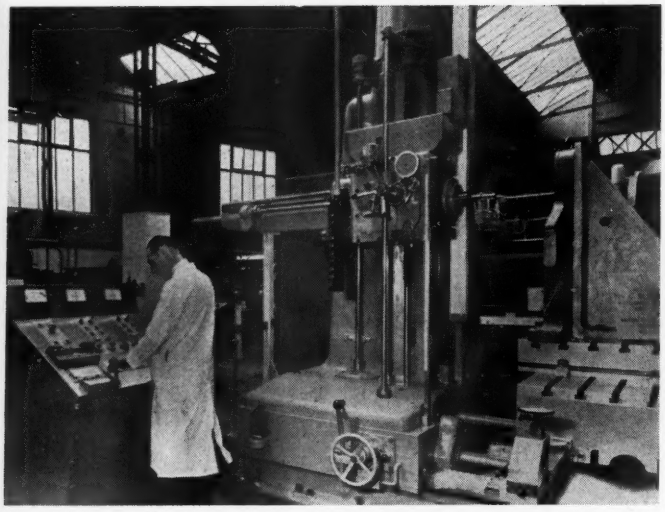


The first 60 MW set at Meaford "B" power station, designed for initial steam conditions of 1,500 lb/sq in and 1,050 deg F, continued to run well during the year, and the second set went into commission in October. The sixth 60 MW set at Staythorpe, designed for the standard steam conditions of 900 lb/sq in and 900 deg F, has also gone into service. Two further 30 MW sets at Goldington power station have been commissioned.

Considerable development work was undertaken during the year, the most interesting being the preparation of layouts for a 275 MW, 3,000 r.p.m., tandem compound reheat turbo-alternator set designed for steam conditions of 2,350 lb/sq in and 1,050 deg F, with reheat to 1,000 deg F. Designs for machines above this rating are also in hand, and development proceeds on 200 MW units.

The rapid development of nuclear power reactors of the graphite-moderated CO_2 cooled type has called for the development of gas circulators of very high ratings and for means for containing and controlling the flow of pressurised gas in very large quantities. A design of gas circulator, together with a drive suitable for the conditions of nuclear power station operation, has been developed, and an experimental model is being made. Some noteworthy developments have also been made in turbo-blowers and compressors. One of these special-purpose machines, developed for the National Coal Board, is designed to deliver air at 2,000 cu ft/min and 18 lb/sq in for use in connection with pneumatic stowage underground.

In November, the Roxburgh station of the State Hydro-Electric Department of New Zealand was officially opened; the plant comprises four B.T.H. 44,444 kVA, 40 MW, 136·4 r.p.m. vertical generators, driven by Francis-type turbines supplied by the Dominion Engineering Co., Ltd., Canada. Included with the B.T.H. generators were voltage regulators and auxiliary control panels. During the year the two 66,667 kVA alternators for Eildon power station, Australia, were completed at



The B.T.H. electronic system of automatic co-ordinate setting is applied to this Kearns horizontal boring machine

Rugby, and one was commissioned in November. The Finlarig power station of the North of Scotland Hydro-Electric Board was also completed. In the Owen Falls power station, Uganda, Nos. 5 and 6 generators have been commissioned, and Nos. 7 and 8 completed at Rugby.

During the year a contract was received from the Federal Power Board of Rhodesia and Nyasaland for the 330 kV switchgear for the Kariba hydro-electric scheme, covering the complete outdoor switchyards at the power station site and at substations at Kitwe, Norton, Salisbury, Umniati and Bulawayo. This is believed to be the largest switchgear contract ever placed in this country for export and includes twenty-three 7,500 MVA type JW lenticular tank oil circuit-breakers.

Additional 132 kV, 3,500 MVA, type OW " Shuntarc " breakers are to be supplied for extensions to the C.E.A. stations at West Melton and Marchwood, and to the new South of Scotland Electricity Board substation at Chapelcross; and a new three-switch 2,500 MVA station has been ordered by the Yorkshire Division for Silsden. On the export side, orders have been received from India and South Africa.

The year has been exceptional for B.T.H. rectifiers, both as regards the volume and variety of the plant produced and its technical interest. Highlights include the very important application of air-cooled pumpless rectifiers to aluminium refining; further developments in connection with high-power semi-conductor rectifiers; and expansion of manufacturing facilities.

The ships selected for the Russian Antarctic Expedition included the *OB* and *Lena*. These are both 12,600 ton ships propelled by B.T.H. diesel-electric equipment, each having four diesel-driven d.c. generators supplying power to a 7,000 s.h.p. double-unit propeller motor. Seven paddle tugs, each powered by a B.T.H. diesel-electric propulsion system, have now been ordered by the Admiralty, and successful sea trials have recently been completed on the first.

Work is proceeding satisfactorily on the ten 800 h.p. complete diesel-electric locomotives for British Railways and the twenty sets of power equipment for the 1,160 h.p. diesel-electric locomotives, the mechanical parts for which are being built in B.R. workshops.

In the aircraft field the range of electrical machines and control equipment has been appreciably increased, particularly that for use on 400 c/s power systems. Extensive development work has also been carried out on all classes of equipment for use in very high ambient temperature conditions which will have to be met in future for high-speed aircraft.

The volume of mining business has continued to increase, particularly for car-handling and surface installations. The majority of mine car-handling electrical equipments now in hand are for " all-electric " drives, but work is proceeding on some combined electrical and pneumatic drives. Great interest is being taken in multi-motor control boards, which are fitted with draw-out contactor panels. The ease with which these panels may be changed can considerably reduce down-time for servicing and operational fault finding. An example of this is the 13-panel type MMC board in hand for Taff Merthyr Colliery. This will control the surface motors driving conveyors, crushers and screens, and sequence interlocking will be provided between contactors.

Following the two large rolling mill drives installed in Australia in 1955, another large equipment has been put into operation. This is the drive for a 12in continuous merchant mill supplied to the order of Australian Electrical Industries Pty., Ltd., Australia, for the Broken Hill Pty., Co., Ltd., Kwinana, Western Australia, and comprises six 600 h.p., 200/600 r.p.m. d.c. motors, a 3,000 kW synchronous motor-generator set and a large cubicle-type control board.

A second large drive to be started up is that for a rotary forge mill for large seamless tubes at Stewarts & Lloyds, Ltd., Clydesdale Works, Glasgow. This comprises two 2,200 h.p., 55/115 r.p.m. d.c. motors with synchronous motor-generator set for driving gap roll mills, and two 3,000 h.p., 500 r.p.m., 11 kV synchronous motors for driving elongators. The largest drive to be started up is that for the five-stand tandem strip mill for the Steel Company of Wales, Ltd., at Velindre.

Orders have been received from William Asquith, Ltd. (for C. A. Parsons & Co., Ltd., and Davy & United Engineering, Ltd.) for 10in spindle, horizontal boring and milling machine drives. The Parsons equipment has a 50 h.p. drive to the spindle, and that for Davy & United Engineering has a spindle motor nominally rated at 80 h.p. but capable of 100 h.p. duty over periods of two hours. These machines are designed for milling, drilling, and boring very large workpieces, and the various motions are driven by B.T.H. motors totalling approximately 190 h.p. Electronic steering control is provided for the horizontal and vertical feed motions.

There has continued to be considerable development and production activity on electronic equipment throughout the year and much effort has been applied to the electronic control of machine tools and special customer applications of electronics. In addition, considerable work has been done in connection with actuator mechanisms and related apparatus for rod control in nuclear power reactors.

British Nuclear Energy Conference

AT a meeting of the board of the British Nuclear Energy Conference on 9th January, under the chairmanship of Sir John Cockcroft, O.M., K.C.B., F.R.S., it was decided to admit to membership the Iron and Steel Institute and the Institute of Metals. The original constituent members were the Institutions of Civil, Mechanical, and Electrical Engineers, the Institute of Physics, and the Institution of Chemical Engineers. It had for some time been felt that the organisation would be strengthened by including representatives from the field of metallurgy.

Modern Commercial Horticulture

Economic Applications of Electricity

IN a paper presented before the Utilisation Section of the Institution of Electrical Engineers on 17th January, Messrs. C. A. Cameron Brown and A. W. Gray (Central Electricity Authority) discussed developments over the past ten years in the use of electricity in modern commercial horticulture. No exact basis yet existed, they said, for determining potential consumption, but the National Farm Survey of 1943 showed that in England and Wales there were then 5,200 market garden holdings and a further 2,900 classified as mixed—all over five acres; in addition there were 70,000 of less than five acres. Two electrified installations were referred to as consuming 250,000 kWh/year each.

Warming of soil before planting in glasshouses had cut down to a day or two the two or three weeks of glasshouse space heating formerly required to attain an adequate soil planting temperature. Expectations that the maintenance of root temperatures to enable the greenhouse general temperature to be reduced, thus economising in space heating, had not been fulfilled. The real gain in hotbed production was to give up to seven croppings in a year from the same frame. Low-voltage transformer-fed bare wires at 30 V (maximum) provided the only really safe method for soil warming installations; specific loadings varied from 5 to 7·5 W/sq ft for a parallel-series arrangement of galvanised steel wires.

For the provision of bottom heat for propagation, by seed germination or by cuttings, and subsequent growth, local soil warming avoided the need to keep the temperature of the whole house at 60 deg F or more. Loaded at 5 to 7 W/sq ft, the wire or cable was laid in a bed of moist sand, not peat or cinders. Propagation temperatures could be controlled most satisfactorily by a "Simmerstat" and thermometer rather than by a thermostat.

A non-horticultural use of soil warming suggested was for the prevention of freezing of football pitches. Mains-voltage tough plastic-covered cables, laid by mole plough and loaded at 8 W/sq ft, were now available. The total kW required would be 500 and during a sustained frost, with a nightly warming and possibly a Saturday morning boost, the consumption would be 40,000 kWh/week costing, at 1d/kWh, £150, only a small fraction of the gate money otherwise lost. A capital cost of even £5,000 would be negligible compared with loss by injury of a first-class player.

Glasshouse Heating

After labour the largest single expenditure was on heating glasshouses. To maintain an inside temperature of 60 deg F against a minimum of 20 deg F outside would require 1,100 kW of heating equipment for an acre of tomato-growing glass requiring 1,200,000 kWh in Southern England and 1,600,000 kWh in colder areas. As the load could not be kept off-peak, the economic scope for electricity would generally be limited to operating essential auxiliaries (particulars of which were given in the paper) for improved coal or oil installations.

High running cost of space heating was generally due to oversetting of the thermostat; for protection against frost 42 to 45 deg F was ample and in the spring 55 deg F. The basis temperature for glasshouse heating calculations should not exceed 20 deg F; the new standard recommendation of 29 deg F referred only to normal buildings of high thermal capacity.

In lighting, most attention had been paid recently to process lighting which had a threefold effect as follows:—Intensity, controlling the rate of plant growth, i.e. bulk increase of stem and leaf; colour, controlling plant shape, i.e. elongated or compact; and duration, controlling development toward maturity and production of flowers and fruit. From this effect three established techniques had been developed: supplementary lighting to augment natural daylight in winter; extended lighting to increase the hours of continuous light each day; replacement lighting in place of natural light in thermally insulated dark buildings.

The nearest known approach to a fully automatic greenhouse, measuring 19 by 10ft, had been run with entirely automatic ventilation by a 12in extractor fan combined with electric heating for over a year with excellent results. With ventilators and doors closed, up to 0·33 air changes per hour were obtained. A metal-sheathed mineral-insulated cable with an overall plastic sheath had been developed which was claimed to be impervious to attack from any chemicals likely to be encountered in horticulture.

World Power Conference

THE 1957 sectional meeting of the World Power Conference to be held in Belgrade, Jugoslavia, will probably extend from 5th June to 11th June—one day longer than previously announced—after which there will be study tours. Seventeen papers are to be submitted by the British National Committee (chairman, Mr. J. Eccles, C.E.A.). Those having an electrical bearing are as follows:

"Power Supply and National Production," by R. Y. Sanders (C.E.A.); "Investment in Fuel and Power in Under-Developed Countries," by G. H. Daniel (Ministry of Fuel and Power) and Professor E. A. G. Robinson (Cambridge University); "Economic Factors Affecting the Establishment of a Nuclear Power Industry in Under-Developed Countries," by J. A. Jukes (U.K.A.E.A.); "Dokan Dam Project in Iraq," by G. M. Binnie (Binnie, Deacon & Gourley); "Integration of Hydro-Electric and Thermal Power Plants," by J. Henderson (South of Scotland Electricity Board); "Underground Gasification in Great Britain," by C. A. Masterman (N.C.B.); "Design of Nuclear Plants," by H. S. Arms (English Electric, Babcock & Wilcox and Taylor Woodrow); "Diesel Engines and Gas Turbines in Under-Developed Countries," by G. B. R. Feilden (Ruston & Hornsby); "Electrical Power and Agricultural Productivity in Under-Developed Countries," by C. A. Cameron Brown (C.E.A.) and H. R. J. Baigent (Southern Electricity Board); "Economics of Local Energy Resources for Agriculture in Under-Developed Areas," by E. W. Golding and P. G. Finn-Kelcey (E.R.A.); "Electricity Distribution in Rural Areas," by R. J. Rennie (South of Scotland Electricity Board); and "Steam and Power Generation in Metallurgical, Chemical and Allied Industries," by G. Cooke (Simon-Carves).

Letter to the Editor

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents

Meter Reading by Photography

MR. ENTWISTLE'S letter in your issue of 28th December contains constructive comment on my proposal for increased mechanisation of electricity accounts and I acknowledge his expert analysis of the computer and memory mechanism. My plan lacked detail, which is the prerogative of the expert, but I doubt if the problem as posed is without economic solution. Manual operations can usually only be displaced by expensive machinery and increased capital investment is thus synonymous with improved efficiency.

It was envisaged that the consumer's number would be inscribed on the meter and photographed simultaneously with the index; if the reader has to place a card in front of the camera the whole simplicity of the one-handed process is destroyed.

I am glad that the first critic considered photography feasible because Mr. H. S. Petch in his letter published in the 11th January issue does not. Moreover Mr. Petch dismisses the proposals because they were considered and rejected by old hands years ago. This is an unrealistic approach since it concludes that there has been no advance in the equipment required to implement the original scheme.

Mr. Petch's observation on non-access calls and time between consumers' premises is valid enough but the human problems of meter reading (or perhaps meter readers) may have eclipsed progressive thought in his particular area. There is room for improvement in all things and publication of ideas is a step forward. My proposal was not the panacea but did seek to be constructive and I welcome the discussion it provoked; a reiteration of known difficulties would not have done this.

Southgate. G. T. SHEARS.

National Inspection Council

THE chief executive and secretary of the National Inspection Council for the Electrical Contracting Industry, Brigadier W. G. S. Thompson, tells us that last month the Council approved an establishment of fourteen inspecting engineers, corresponding to the number of Electricity Areas in England and Wales, plus two for Scotland.

Messrs. J. J. Looker, Associate I.E.E., and H. F. Smith, who were with the National Register of Electrical Installation Inspectors, have been appointed inspecting engineers for the London and the North Western Areas respectively. From over 1,360 applicants 45 were selected on a short list and from these the following have been appointed: —

South Eastern Area.—Mr. R. E. M. Hunter, A.M.I.E.E. (Insurance Engineers, Ltd.). *Southern Area.*—Mr. T. Howell, Associate I.E.E. (Dicks, Ltd.). *South Western Area.*—Mr. H. J. Slaughter (Drake & Gorham (Contractors), Ltd.). *Eastern Area.*—Mr. H. C. Breeze (London Electricity Board). *East Midlands Area.*—Mr. R. A. Headland (H. J. Haseldine, Ltd.). *Midlands Area.*—Mr. E. W. Roper (Frank Hancock (1939), Ltd.). *South Wales Area.*—Mr. D. B. J. Williams (Drake & Gorham (Contractors), Ltd.). *Yorkshire Area.*—Mr. P. Laughton (Vulcan Boiler & General Insurance Co., Ltd.). *Merseyside and N. Wales Area.*—Mr. A. Kay (North Western Electricity Board). *North Eastern Area.*—Mr. J. Pidgeon, Associate I.E.E. (Barlow, Leslie & Partners). The two Scottish inspectors are still to be appointed. A Scottish Committee of the Council is being formed.

Certificates for enrolled approved contractors are being engrossed and signed at the rate of about 250 a week and the first Roll of Approved Installation Contractors is being prepared. It is intended to compile the Roll in two sections —geographical and alphabetical—and it is expected that it will be published by March.

Electros and rubber stamps of the Council's emblem are now available to approved contractors from Brigadier Thompson at 13, Victoria Street, London, S.W.1.

News from Australia

Amalgamated Wireless (Australasia), Ltd., and Email, Ltd., two of Australia's largest electronic organisations, are examining the desirability of a merger. Email also proposes to make a one-for-one bonus issue to shareholders, after which the combined capital of the two merging companies would be £7,757,896.

The Chamber of Manufactures holds the view that effective protective tariffs are preferable to the fixing of import quotas. On this subject the Tariff Board states: "An effective control mechanism could undoubtedly be used through the tariff, by the imposition of duties varying in intensity to levels that are absolutely prohibitive, but the long-run disadvantages of such a scheme would outweigh the short-run advantages, to say nothing of the problems that would be created by violation of international agreements."

The present improvement in Australia's overseas funds position makes it probable that the import licensing system will again be overhauled early in the New Year, and there is considerable talk in official circles suggesting that import licences will then be eased.

Importers of electrical goods who experience undue delays in deliveries were not surprised when the Stevedoring Industry Authority disclosed that during the month of August more than 214,000 man-hours of work were lost on Australian wharves. However, even that figure was a "considerable improvement" on the position in July when more than 555,000 man-hours were lost. There were many dismissals of waterside workers for insufficient effort and go-slow tactics and in many instances men ceased work, claiming that they were "too fatigued" to continue.

Mr. E. B. Sawyer showing various types of lamps to London schoolchildren who attended a lecture on "Lamps and Lighting" at the Lighting Service Bureau on 2nd January

Heat Pump Operation

Discussion on I.E.E. Utilisation Section Paper

THE discussion on "Some Aspects of Heat Pump Operation in Great Britain," the paper presented by Miss M. V. Griffith before the I.E.E. Utilisation Section on 10th January and summarised last week in the *Electrical Review*, was opened by Mr. J. A. Sumner (Eastern Electricity Board). Compared with a car costing £400 without or £600 with purchase tax, the heat pump should, he held, be cheaper than it was. The need for it would become so great and so evident that its market would be made, since the shortage of fuel would necessitate the finding of alternative means of providing heat before atomic power came into wide use.

Mr. F. W. Skelcher (C.E.A.), speaking from practical experience of two heat pump installations, suggested that more attention should have been devoted to lubrication, the migration of refrigerant and the entrance of moisture into the system. Otherwise, there had been no major difficulties. The pumps heated administrative offices and gave a comfort level that was entirely satisfactory. Insufficient attention had been paid to the heat pump by advisory fuel economy committees.

Dr. J. W. Macfarlane (Macfarlane Engineering Co., Ltd.) described a heat pump he had had built at home to avoid personal transport of solid fuel. It had turned out to be if not an efficient at least an amenity instrument of considerable value. For the last three years he had had a domestic hot water heat pump consisting of a ½ h.p. hermetic refrigerator unit taking its source of low-grade heat from the atmosphere. The coefficient of performance was about 3·9 and it showed a marked advantage over an immerser of nearly 3·1 to 1.

Use Limited by Cost

Mr. P. E. Montagnon (Ministry of Fuel and Power) submitted that the little use made of heat pumps was due to their high cost, but with the increasing fuel gap and the increased price of fuel they would, he felt sure, come into their own.

Mr. Bryan Donkin (Kennedy & Donkin) said that on the facts submitted the heat pump hardly seemed successful for heating domestic buildings for not more than seven months in the year. However, it would be well worth while where the annual load factor was really good.

Mr. P. Schiller (C.E.A.) thought the paper should be supplemented by deeper consideration of the electricity supply economics aspect. So far the economics of the heat pump had been considered mainly from the point of view of the consumer on the basis of a certain tariff, say, 1d per kWh, perhaps on the assumption that at that price it must be economical to supply heat pumps. He could not agree.

Mr. Fletcher said he also had installed a domestic heat pump as a means of avoiding carrying coal. Heat was obtained part of the time from an air evaporator and part of the time from a tank for dirty bath water. The responsible authorities ought to press for a reduction in or the abolition of the crippling purchase tax where fuel saving was shown, as with heat pumps.

Mr. R. F. Richardson (C.E.A.) suggested that insufficient emphasis had been laid on the potential development of the heat pump for large office buildings, theatres, cinemas and certainly in hotels where air-conditioning plant was installed. The aim should be to use every air-conditioning plant for cooling in summer and warming in winter.

Mr. R. A. W. Connor (Eastern Electricity Board) said that although it would be some time before the traditional domestic coal fire disappeared, a very big load would come to the supply industry from heating to higher standards in all other applications. Capital costs were still very high but many of the technical difficulties had been overcome. There was one non-technical difficulty —that of selling a heat pump to a consumer who used very little hot water and for this reason its major use would be in medium and large domestic premises in the first instance.

Mr. H. A. Scholar referred to the use by the municipality of Zurich of the heat pump for heating buildings, to the extent of 9·6 per cent as compared with 1 per cent by electricity and 73 per cent by coke. It had turned out to be a very good investment. There must one day, he thought, be an enormous export market for heat pumps, but export, like charity, began at home. A manufacturer should start with a home market, so that any defects could be put right before goods were sent abroad, perhaps to very distant countries where correction of defects would be much more costly and reputations were more easily lost.

Mr. J. A. Feasby said that his interest had been largely in larder-cooling and water-heating by heat pumps, which he had developed and produced commercially. The earlier models had a p.e.r. between 1 and 1·5 and the later models a p.e.r. between 2 and 3. This was achieved with source temperatures down to 30 deg F and water temperatures up to about 148 deg F.

Mr. H. J. Eighteen (E.R.A.) described some of the mechanical difficulties which had to be overcome in the development of the Shinfield heat pump. These included leakage of refrigerant and compressor lubrication. No serious difficulties were experienced, however, and except for teething troubles it had given good service.

Telecommunication Symbols

THE fourth supplement to B.S. 530: 1948, "Graphical Symbols for Telecommunications," has just been published by the British Standards Institution. While B.S. 530 was being revised, an inter-Service list of symbols was issued, which differed from those in the British Standard. Later, the Services agreed to use instead, B.S. 530 and its supplement, together with an addendum listing these differences.

Supplement No. 4, "Miscellaneous Recommendations and Symbols (including Transistors)," has been drafted, mainly with a view to removing these differences, and it will now be possible for the Services to reduce substantially the size of their addendum. Supplement No. 4 contains guiding principles for the preparation of circuit diagrams, which are additional to those on pages 5 to 15 of B.S. 530, and new or modified symbols which reflect advance in technique. Symbols for transistor and allied devices, keeping pace with recent advances in semi-conductor developments, form an important part of the supplement. In drafting these, attention has been paid to American practice.

Copies of the new supplement are available from the B.S.I., 2, Park Street, London, W.1, price 3s 6d.

GENERATION AND DEVELOPMENT

County Council Defers Decision on Nuclear Project

Having discussed a report of its Planning Committee on meetings with representatives of the Central Electricity Authority and the local authorities affected, Somerset County Council recently decided to defer any decision on the plans for the proposed atomic power station at Inkley Point until March, when the Planning Committee hopes to present a complete report.

Lord Hylton, chairman of the Committee, said that the site chosen was 4½ miles from the Quantock Hills, one of the most important holiday areas in the county. Many important matters about water supplies, new roads, overhead lines and housing for staff had to be considered and he had urged that any attempt to reach a quick decision should be resisted. The proposed plant would require 250,000 gallons of fresh water daily and 20 million gallons of sea water hourly for cooling purposes. This, they had been told, would increase the temperature of the sea in the Bristol Channel. They were assured that there would be no danger to bathers.

City Hall Supply Conversion

Renewal of the main cables between the switchboards and distribution boards in Cardiff City Hall in connection with the change-over from d.c. to a.c. is expected to be completed by the end of the current financial year. The city surveyor has recommended that the final circuits in offices and other rooms should be renewed, and that the lighting in certain offices should be improved. The approximate cost of the total scheme is £12,000 and it is recommended that £4,000 should be included in next year's estimates towards the cost of reorganising these final circuits.

Electricity Board's Management Conference

Last week the Eastern Electricity Board held the 37th in a series of management conferences at a Clacton hotel. The objects of these conferences are to secure frank and open discussion of the Board's major administrative and operational problems between members of the staff of all senior grades, to ensure that the staff understand the Board's policy in dealing with such problems and also to foster mutual interest in the work of the Board at all levels. At last week's conference thirty employees holding responsible positions with the Board were divided into three syndicates each under a leader and were asked to discuss and to resolve a problem in management set by the conference leader, himself a manager of one of the six Sub-Areas of the Board. The syndicates were required to produce written reports upon the problem which were considered by the conference leader and one of the Board's chief officers and another sub-area manager and then discussed by the conference as a whole. Opportunity was also provided for members to put questions to the chairman of the Board (Mr. C. T. Melling) on any matter affecting the Board's policy and work.

Hexham Reinforcement

The North Eastern Electricity Board is to reinforce the supply system in Hexham and the surrounding area by erecting a 66 kV overhead line from Dunston power station to Hexham. The work is expected to be completed by next winter, and will enable the Board to meet the growing demand for electricity in the district and many other nearby towns.

Unsafe Electrical Appliances

Carlisle City Council was recently asked by the North Western Electricity Consultative Council whether a local by-law could be introduced to prohibit the sale of old electrical apparatus, particularly second-hand fires, which might be dangerous. It decided to refer the matter to the Association of Municipal Corporations, which may be asked to approach the Government to introduce legislation to protect the public.

Helicopter Used in Pipe-line Repair

A serious break in the North of Scotland Hydro-Electric Board's Loch Sloy pipe-line on The Cobbler, above Loch Long, on 5th December was repaired on 7th January when eleven tons of building materials were transported 1,000ft up by helicopter operating from Arrochar.

Floor Warming for Flats

South Shields Town Council has decided to install under-floor electric heating in 243 three-storey flats to be erected in the Laygate area. Representatives of the Council recently inspected a similar installation in a housing scheme at Kirkcaldy, Scotland, and expressed satisfaction with the system.

Milled-Peat Station Almost Ready

Ireland's "cheap fuel" electricity project at Ferbane, Offaly, will be ready for its initial testing next month. The Electricity Supply Board's new power station, almost completed, will use milled peat, which is regarded as the cheapest fuel for generating electricity. Over a year's supply has already been accumulated in the bogs adjoining the station. Elevators will carry the turf to the boilers.

Power Charges Raised in I.O.M.

A temporary increase of ¼d/kWh in power charges because of the higher price of oil has been announced by the I.O.M. Electricity Board. The position of domestic supplies is to be considered later. In Douglas, where electricity is produced from coal, the charges are unaltered.

OVERSEAS

Load Development in Singapore

A report just received from Mr. R. A. Waddle, B.Sc., M.I.E.E., city electrical engineer of Singapore, tells of the progress of electrical development in the city. Although seriously handicapped by not having a showroom, the Electricity Department in 1955 hired out an additional 6,000 cookers (making 14,195 on hire at the end of the year), 2,192 water heaters (5,914) and 11,178 fans (39,009). Motors on hire decreased from 424 to 412. To promote night load it was proposed to introduce a hire-purchase scheme for air-conditioners for which there appeared to be a public demand, but the project had to be shelved as it infringed a by-law under which the City Council is not allowed to compete with private traders in the sale of appliances on deferred terms. Mr. Waddle says it has been suggested that an amendment of the by-law should be sought.

New consumers connected by the Department in 1955 numbered 6,390, with an increased connected load of 73,501 kW, and sales of electricity rose by 16·1 per cent to 321 million kWh. With the installation of a further 25 MW turbo-generator and two boilers, the installed capacity at the Pasir Panjang power station was increased to 100 MW. Blade fouling by silica deposition reduced the efficiency of No. 2 turbine during the first two months of the year.

There was a trading surplus of $1·7 million, which was utilised primarily for the purchase of motors and domestic appliances for hire, and the final result of the year's operations was a net deficit of $1·3 million.

Hirakud Dam Inaugurated

Last week-end Mr. Nehru, by pressing a button which opened the spillway and lit floodlights for a stretch of six miles, inaugurated the Hirakud Dam on the Mahanadi River in Orissa. It is part of a £75 million irrigation and power project and when the second stage is completed by 1960 it will have a total installed capacity of 232·5 MW.

Australian Electricity Production

In 1955-56 electricity production in Australia rose by 1,490 million kWh (9·7 per cent) to a total of 16,788 million kWh.

"Main" Domestic Appliances

DETAILS of an improved refrigerator model for 1957, the "Main No. 36," were announced last week by R. & A. Main, Ltd., which as from 1st January has taken over the manufacture and marketing of refrigerators from Main Refrigeration, Ltd. It has the same outer cabinet as the company's original 3·2 cu ft model, but the internal capacity has been increased to 3·6 cu ft and the shelf area from 6·3 to 7 sq ft. This has been achieved by the addition of a recessed door lining fitted with an egg rack and two shelves. The price is the same as for the previous "No. 32" model, namely, £49 17s plus £22 12s purchase tax in the United Kingdom.

The refrigerator is of the absorption type, 46¼in high by 24½in wide by 24¾in deep, and is guaranteed for one year, the sealed cooling unit being guaranteed for ten years. After-sales service will be undertaken by the Main Morley Service organisation which has depots at Edmonton, Padiham and Falkirk.

Modern and attractive in design, the refrigerator has a bowed top and shaped door, secured by a positive catch. Immediately beneath the door is a hinged plinth panel giving access to a dry storage compartment. This compartment, of 1½ cu ft capacity, is not refrigerated. The evaporator is constructed to give a frozen-food storage compartment large enough for the needs of the average family. Masked by a white plastic cover with drop door, the evaporator will accommodate the two ice trays supplied, plus about 4 lb of prepacked frozen foods. With the ice trays removed, the capacity is 6 lb. The cabinet is fitted with two full-width shelves and one half-width shelf, in chromium finish. The bottle shelf is reversible.

The thermostat is fitted under the ventilation grille for ease of maintenance and the control, situated in the top breaker strip, maintains a constant temperature in the cabinet.

The "Main No. 55" wash boiler, a product of the associated company, Morley Products (Padiham), Ltd., is a compact cabinet model. The "No. 55 Plus" incorporates a built-in self-adjusting wringer with fold-away handle and a clothes rest to support the clothes as they emerge from the rollers. This appliance costs £25 15s including 18s 6d purchase tax on the wringer. The lid is so designed that a special hand agitator, available as an optional accessory for £1 19s 8d including 7s 2d purchase tax, can be fitted into it without tools.

Provision is made for the "No. 55" to be converted into a "No. 55 Plus" by the addition of a modified top rim with wringer attached, which can be purchased separately.

The new models incorporate a feature claimed to be new to electric wash-boilers, press-button heat control with twin neon indicator lights. Separate press-buttons are provided for "high" and "low" heat control and also for "off." The circuit is protected by a safety cut-out. The boiler, which has a full 10 gal capacity, is heated by two 1½ kW tubular sheathed immersion elements operating on 200/220 or 230/250 V a.c.

Constructed throughout from mild-steel sheet with all seams welded, the wash-boiler is finished inside and out in easy-to-clean vitreous enamel. Model "No. 55" measures 15½in wide by 18in deep by 29in high and the "55 Plus" with its attached wringer is 4in higher. The weight is 30 lb and smooth-running swivelling castors are fitted. In the case of the "55 Plus" the two rear castors are replaced by rubber feet to give stability when using the wringer. The "Main No. 55 Plus" is illustrated on page 125.

"Main No. 36" refrigerator

Arts and Crafts Exhibition

The London Electricity Sports and Social Association (LESSA) informs us that in view of the present fuel position the London District Joint Advisory Council has asked it to postpone its Arts and Crafts Exhibition, which was to have been held on 25th and 26th January. The new date will be announced later.

Control Apparatus Manufacturers' Luncheon

THE prospects were that our external trading account would still be roughly in balance for the year ending in April next, stated Mr. F. J. Erroll, M.P., Parliamentary Secretary to the Board of Trade, at the annual luncheon on 8th January of the British Industrial Measuring and Control Apparatus Manufacturers' Association (BIMCAM). Mr. Erroll pointed out that after the difficult year of 1955, the year 1956 had shown a healthy improvement. For the first eleven months, imports were only 1 per cent higher in value than in 1955, while exports were 6 per cent higher in volume and 10 per cent higher in value. BIMCAM members played an important part in direct exporting and in promoting the efficiency of other exporting industries by means of their products. Nuclear plants could not be operated without a full range of control instruments. The Board of Trade had recently set up an Instrument Industry Advisory Committee, which was due to meet for the first time this year. He was confident that this new body would provide a most useful liaison between the industry and the Government.

Mr. R. G. Kent, chairman of the Association, referred to the formation by the Association of an Education Committee, which should result in material advances in technical education in the field of industrial instruments. He paid a tribute to Mr. L. S. Yoxall, president of BIMCAM, who is chairman of the joint committee responsible for the Instruments, Electronics and Automation Exhibition to be held in London in May.

At the annual luncheon of BIMCAM. Left to right: Mr. F. J. Erroll, M.P. (Parliamentary Secretary to the Board of Trade), Mr. L. S. Yoxall (president, BIMCAM), Mr. R. G. Kent (chairman) and Dr. W. A. Macfarlane (chief executive, National Industrial Fuel Efficiency Service)

DOMESTIC ELECTRICAL EQUIPMENT

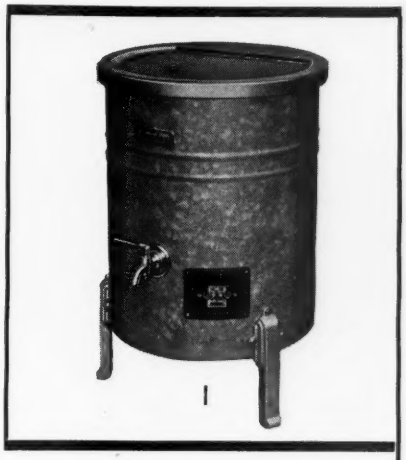
Wash Boilers

As a quick and convenient means of providing a supply of hot water for the weekly wash the electric wash boiler is an important item of home laundry equipment. Present-day models are manufactured and designed to give many years of good service and the latest cabinet types, stove enamelled in various colours, blend well with other kitchen equipment. In addition they are usually provided with castors for easier manœuvrability and their removable tops serve as an additional table or working surface.

The galvanised round types, however, still retain their popularity and most manufacturers list a model or models in their range. The average capacity of the wash boiler is in the region of ten gallons and the loading 3 kW. An automatic cut-out device, to safeguard the boiler should it be switched on when empty or left to boil dry, is an optional extra with many makes. Some models are fitted with a hand wringer and others can be adapted to serve as manually-operated but electrically heated washing machines by the insertion of some form of hand agitator unit.

For the convenience of the flat dweller or for use in confined spaces, there is also a smaller 4-gal "bucket" type boiler. With a loading of 1½ or 2 kW, it is also suitable for boiling puddings, fruit bottling, etc.

Manufacturer	Name or Model	Type	Size (H.W. & D. in inches)	Tub Capacity	Wringer	Agitator	Loading	Method of Control
ALDER ELECTRICAL APPLIANCES, LTD., Rushworth Street, Burnley, Lancs.	Alder "XR"	Round	27⅞ × 19¾ diameter	10 gal	No	No	3 kW	3-heat, 2 foot-press switches
AMPLEC, LTD. Grange Works, Grange Lane, Accrington.	"Wringer Amplewash"	Cabinet	36½ × 18½ × 18½	10 gal	Yes (plus £1 7 4 purchase tax)	Optional extra	3 kW	Rotary 3-heat switch
	"Amplewash" Boiler	Cabinet	30 × 16½ × 16½	10 gal	No	No	3 kW	Rotary 3-heat switch
	"C.R.S."	Round	27⅞ × 17½ diameter	10 gal	No	No	3 kW	2 foot kick switches
	"R.J."	Round	27 × 16½ diameter	8 gal	No	No	3 kW	2 foot kick switches
	"Star Styled"	Cabinet	29¾ × 16⅜ × 16½	10 gal	No	No	3 kW	Rotary 3-heat switch, cut-out 25s extra
BRADLEY & CO., LTD., Albion Works, Bilston, Staffs.	"Beldray" 329	Round	—	4½ gal	No	No	2 kW	Direct from plug. Cut-out
BRUNLEC APPLIANCES, LTD., Junction Mills, Junction Street, Burnley.	"600" Boiler/Wringer	Cabinet	30 × 17 × 17	10 gal	Yes (plus 18s 10d purchase tax)	Optional extra	3 kW	3-heat push-button switch
	"500 F"	Cabinet	30 × 17 × 17	10 gal	No	No	3 kW	3-heat push-button switch
	"540"	Round	27 × 19 diameter	10 gal	No	No	3 kW	3-heat foot-press switch
	"560"	Round	27 × 19 diameter	10 gal	No	No	3 kW	3-heat foot-press switch
	"XL"	Cabinet	28 × 16½ × 16½	10 gal	No	No	3 kW	Standard cut-out
BULPITT & SONS, LTD., Icknield Street, Birmingham, 18.	"600"	Round	—	4 gal	No	Percolating type turbulator	2 kW	Direct from plug
BURCO, LTD., Rose Grove, Burnley.	"Baby Burco" 761 (*a*) and 761S (*b*)	Round	19¾ × 16 diameter	5 gal	No	No	3 kW	Direct from plug (*a*) 3-heat d.p. switch (*b*)
	"Baby Burco" E761 (*a*) and E761S (*b*)	Round	19¾ × 16 diameter	5 gal	No	No	2 kW	Direct from plug (*a*) 3-heat d.p. switch (*b*)
	350F	Round	26½ × 16½ diameter	8 gal	No	No	2,625 W	3-heat foot-press switches
	375AS (*a*) and 600AS (*b*)	Round	28 × 17¾ diameter	10 gal	No	Agitator lid unit available £2 15 6 extra	3 kW	3-heat rotary switch
	E375AS (*a*) and E650AS (*b*)	Round	28 × 17¾ diameter	10 gal	No	Agitator lid unit available £2 15 6 extra	3 kW	3-heat rotary switch



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Exterior Finish	Tub Finish	Price
Galvanised	Heavily tinned	£9 15 0
Porcelain enamelled	Tinned copper	£24 10 0
Porcelain enamelled	Tinned copper	£15 15 0
Galvanised	Tinned copper	£9 5 0
Galvanised	Tinned copper	£8 17 6
Pink and green, cream and green or all cream	Tinned copper	£14 0 0
Galvanised	Galvanised	£4 0 0
Cream or white vitreous enamel	Tinned copper	£22 10 0
Cream or white vitreous enamel	Tinned copper	£14 10 0
Grey, cream or white vitreous enamel	Tinned copper	£11 10 0 (cream or white) £11 0 0 (grey)
Galvanised	Tinned copper	£9 7 6
Cream or white vitreous enamel	Mottled vitreous enamel	£10 10 0
Galvanised	Galvanised	£6 10 0
Anodised aluminium	Anodised aluminium	£6 2 6 (*a*) £6 19 6 (*b*)
Cream enamel	Anodised aluminium	£6 10 0 (*a*) £7 7 0 (*b*)
Galvanised	Tinned copper	£9 0 0
Galvanised	Tinned copper	£9 7 6 (*a*) and £11 12 0 (*b*)
Cream enamel (*a*) & white or cream enamel (*b*)	Tinned copper	£12 6 0 (*a*) and £12 18 0 (*b*)

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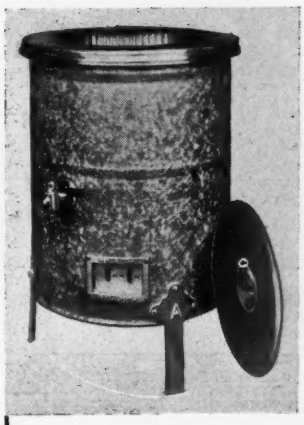
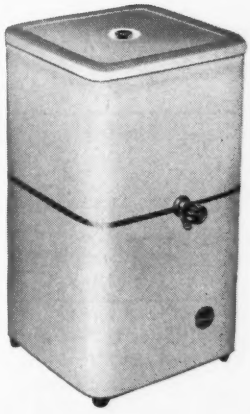


1. *Amplec "CRS" round type washer*
2. *Amplec "Star Styled" cabinet model*
3. *Alder "XR" wash boiler*
4. *Brunlec "XL" wash boiler*
5. *"Baby Burco" 5 gal boiler*
6. *Bradley "Beldray" 329 4½ gal boiler*
7. *Bulpitt "600" 4 gal wash boiler*



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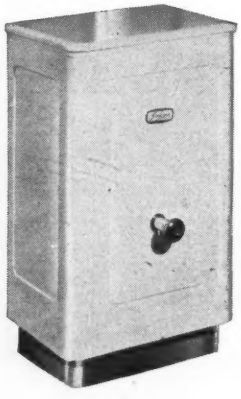
Manufacturer	Name or Model	Type	Size (H.W. & D. in inches)	Tub Capacity	Wringer	Agitator	Loading	Method of Control
BURCO, LTD., Rose Grove, Burnley. (*continued*)	763DX	Round	31¾ × 19¾ diameter	16 gal	No	No	4½ kW	3-heat rotary switch
	E850AN	Cabinet	30½ × 17⅝ × 21½	10 gal	No	Agitator lid unit available £2 15 6 extra	3 kW	3-heat hand-level switch
	E950AN	Cabinet	30½ × 17⅝ × 21½	10 gal	Yes (plus £1 3 5 purchase tax)	Agitator lid unit available £1 16 7 extra	3 kW	3-heat hand-level switch
CHALFONT ELECTRICAL PRODUCTS, LTD., Tyrrell Street, Leicester.	"Popular"	Round	12 × 16 diameter	4 gal	No	No	2 kW	Direct from plug
CO-OPERATIVE WHOLESALE SOCIETY, LTD., Hall Street, Dudley, Worcs.	"Invincible"	Round	12 × 16 diameter	4 gal	No	No	2 kW	Direct from plug
DARLASTON GALVANISED HOLLOWARE CO., LTD., Holyhead Road, Wednesbury, Staffs.	"Red Label"	Round	13 × 16 diameter	4½ gal	No	No	2 kW	Direct from plug. Cut-out
	"Universal"	Round	15 × 15 diameter	4½ gal	No	No	2 kW	Direct from plug. Cut-out
EASICLENE PORCELAIN-ENAMEL (1938), LTD., Darlaston, Wednesbury, Staffs.	"Easiclene"	Cabinet	28 × 16 × 16	8 gal	No	No	3 kW	3-heat switch
GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, London, W.C.2.	DE4763	Round	19 × 27 diameter	9⅛ gal	No	No	3 kW	2 d.p. switches
	DE4764	Round	19 × 27 diameter	9⅛ gal	No	No	3 kW	2 d.p. switches
	DE4765 and DE4765C	Round	19 × 27 diameter	9⅛ gal	No	No	3 kW	2 d.p. switches and cut-out
	DE4759	Cabinet	28 × 16⅝ × 16⅝	9⅛ gal	No	No	3 kW	2 d.p. switches
	DE4760	Cabinet	28 × 16⅝ × 16⅝	9⅛ gal	No	No	3 kW	2 d.p. switches and cut-out
L. G. HAWKINS & CO., LTD., 30-35, Drury Lane, Kingsway, London, W.C.2.	"Dinky"	Round	12 × 10½	2¾ gal	No	No	1½ kW	—
JACKSON ELECTRIC STOVE CO., LTD., Dallow Road, Luton, Beds.	908	Cabinet	30½ × 17½ × 13	10 gal	No	No	3 kW	3-heat s.p. rotary switch
	909	Cabinet	30½ × 17½ × 13	10 gal	No	No	3 kW	2 d.p. switches and cut-out



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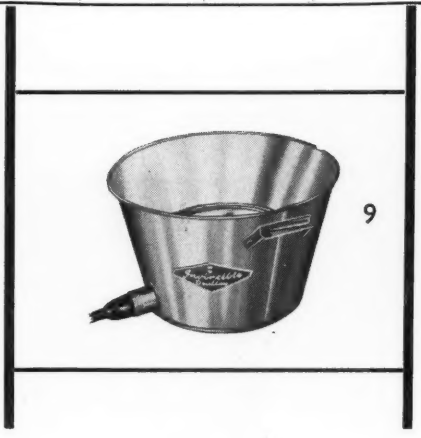

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Exterior Finish	Tub Finish	Price
Galvanised	Tinned copper	£19 15 0
White or cream enamel	Tinned copper	£17 17 0
White or cream enamel	Tinned copper	£25 0 0
Galvanised	Galvanised	£3 7 6
Galvanised	Galvanised	£3 10 0
Galvanised or stoved enamel	Galvanised	£3 19 6
Anodised aluminium or stoved enamel	Anodised aluminium	£5 12 0
White, cream or eau-de-nil	Vitreous enamel	£15 15 0
Galvanised	Tinned	£10 5 0
Galvanised	Tinned	£10 15 0
Galvanised (4755) and enamelled (4755C)	Tinned	£11 15 0 (DE4765) £12 10 0 (DE4765C)
White or honeysuckle enamelled	Tinned	£15 15 0
White or honeysuckle enamelled	Tinned	£16 15 0
Frosted aluminium	—	£3 19 6
Enamelled all-white or all-cream or with turquoise blue or eau-de-nil table top	Tinned copper	£12 12 0
Enamelled all-white or all-cream or with torquoise blue or eau-de-nil table top	Tinned copper	£14 0 0

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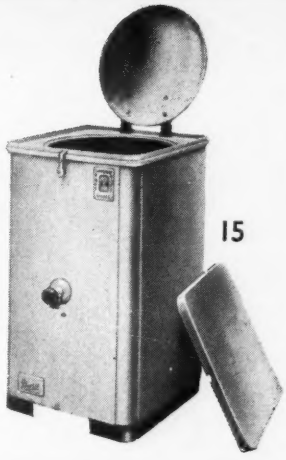

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8. *Jackson model 908 wash boiler*
9. *C.W.S. "Invincible" 4 gal boiler*
10. *L. G. Hawkins "Dinky" 2¾ gal boiler*
11. *Chalfont "Popular" wash boiler*
12. *Easiclene boiler*
13. *G.E.C. round type wash boiler*
14. *Darlaston Galvanised Holloware Co.'s "Red Label" 4½ gal boiler*
15. *Burco "E850AN" cabinet model*
16. *G.E.C. cabinet type wash boiler*

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Manufacturer	Name or Model	Type	Size (H.W. & D. in inches)	Tub Capacity	Wringer	Agitator	Loading	Method of Control
LAMB, HINGLEY & CO., LTD., Lye, Stourbridge, Worcs.	"Apex" 436	Round	12½ × 15 diameter	4½ gal	No	No	2 kW	Direct from plug
	"Apex" 438	Round	25 × 17 diameter	10 gal	No	No	2½ kW	On/off press-button switches
MORLEY PRODUCTS (PADIHAM), LTD., 48, Grosvenor Gardens, London, S.W.1.	"Main 55 Plus"	Cabinet	29 × 15½ × 18	10 gal	Yes (plus 18s 6d purchase tax)	Optional extra	3 kW	Push-button switches, twin indicator lights and cut-out
NORTHERN INDUSTRIES, Snow Hill, Manchester, 4.	"Little Treasure"	Round	10¾ × 15½ diameter	4½ gal	No	No	2 kW	Direct from plug
HERMAN SMITH SMITHLITE, LTD., Empire Works, Dudley, Worcs.	G.1953	Round	26 × 17¾ diameter	10 gal	No	No	3 kW	3-heat rotary switch
	G.1953S.C.	Round	26 × 17¾ diameter	10 gal	No	No	3 kW	3-heat kick switch and cut-out
	E.1953	Round	26 × 17¾ diameter	10 gal	No	No	3 kW	3-heat rotary switch
	E.1953S.C.	Round	26 × 17¾ diameter	10 gal	No	No	3 kW	3-heat kick switch and cut-out
SOUTH WALES SWITCHGEAR, LTD., c/o TREFOREST ELECTRICAL SERVICES, LTD., Pengham Road, Aberbargoed, Bargoed, Glam.	350	Round	28½ × 18½ diameter	10 gal	No	Optional extra	3 kW	3-heat kick switches
	351	Round	28½ × 18½ diameter	10 gal	No	Optional extra	3 kW	3-heat kick switches
	352	Round	28⅝ × 19 diameter	10 gal	No	Optional extra	3 kW	3-heat kick switches
	353	Cabinet	28¾ × 18⅛ × 18⅛	10 gal	No	Optional extra	3 kW	Press-button 3-heat switch
	354	Cabinet	28¾ × 18⅛ × 18⅛	10 gal	Yes	Optional extra	3 kW	Press-button 3-heat switch
F. J. TOMLINSON, LTD., Hall Carr Mill, Rawtenstall, Lancs.	"Handy"	Round	12 × 15½ diameter	4½ gal	No	No	1½ or 2 kW	Ejector safety device
UNIVERSAL BOILERS & ENGINEERING CO., LTD., Fulledge Works, Burnley, Lancs.	RGAC	Round	28 × 19½ diameter	10 gal	No	No	3 kW	Rotary switch
	RGCO	Round	28 × 19½ diameter	10 gal	No	No	3 kW	2 foot-press switches and cut-out
	RSAC	Round	28 × 19½ diameter	10 gal	No	No	3 kW	Rotary switch
	RSCO	Round	28 × 19½ diameter	10 gal	No	No	3 kW	2 foot-press switches and cut-out
	SQAC	Cabinet	29½ × 16 × 16	10 gal	No	No	3 kW	Rotary switch
	SQCO	Cabinet	29½ × 16 × 16	10 gal	No	No	3 kW	2 foot-press switches and cut-out
VACTRIC, LTD., 196, Sloane Street, London, S.W.1.	V.77	Cabinet	30 × 18½ × 22	10 gal	Yes (plus 19s 2d purchase tax)	Optional extra	3 kW	3-heat switch, Cut-out if required
	V.45	Cabinet	30½ × 16¾ × 20⅜	9 gal	No	No	3 kW	3-heat switch, Cut-out if required

Method of Control	Exterior Finish	Tub Finish	Price
Direct from plug	Galvanised	Galvanised	£4 0 0
On/off press-button switches	Galvanised	Galvanised	£8 0 0
Push-button switches, twin indicator lights and cut-out	Cream vitreous enamel	Grey mottled vitreous enamel	£25 15 0 or £16 16 0 (less wringer and clothes rest)
Direct from plug	Galvanised	Galvanised	£3 5 0
3-heat rotary switch	Galvanised	Tinned	£9 19 9
3-heat kick switch and cut-out	Galvanised	Tinned	£11 0 9
3-heat rotary switch	Galvanised	Tinned	£12 0 0
3-heat kick switch and cut-out	Stove enamelled	Tinned	£13 1 0
3-heat kick switches	Galvanised	Tinned	£10 0 0 (s.p. switches) £10 6 0 (d.p. switches) £11 5 0 (a.c. cut-out)
3-heat kick switches	Cream, white, blue or red stoved enamel	Tinned	£11 10 6 (s.p. switches) £11 16 6 (d.p. switches) £12 15 6 (a.c. cut-out)
3-heat kick switches	Cream, white, blue or red stoved enamel	Tinned	£12 13 6 (s.p. switches) £12 19 6 (d.p. switches) £13 18 6 (a.c. cut-out)
Press-button 3-heat switch	Cream or white stoved enamel	Tinned	£15 12 6 £16 17 6 (a.c. cut-out)
Press-button 3-heat switch	Cream or white stoved enamel	Tinned	£24 9 6 (incl. p.t.)
Ejector safety device	Galvanised	—	£3 11 9
Rotary switch	Galvanised	Tinned copper	£11 11 0
2 foot-press switches and cut-out	Galvanised	Tinned copper	£12 18 6
Rotary switch	Stoved enamel	Tinned copper	£13 5 1
2 foot-press switches and cut-out	Stoved enamel	Tinned copper	£14 12 7
Rotary switch	Stoved enamel	Tinned copper	£17 1 0
2 foot-press switches and cut-out	Stoved enamel	Tinned copper	£18 3 0
3-heat switch, Cut-out if required	White enamel	Tinned copper	£23 19 6
3-heat switch, Cut-out if required	White enamel	Tinned copper	£13 19 6

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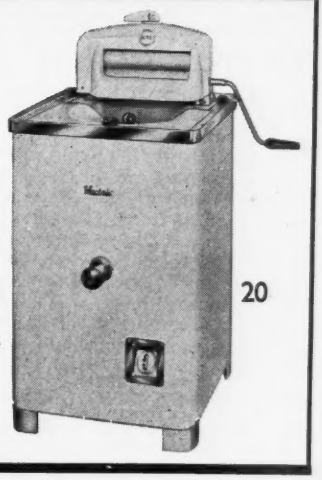

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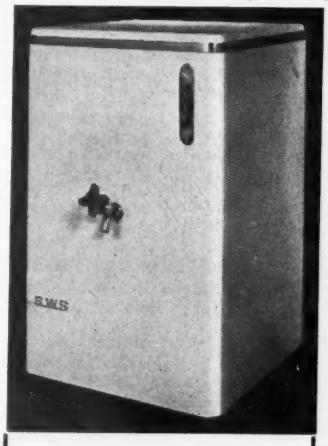

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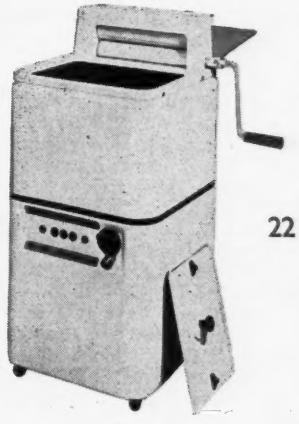

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17. *Herman Smith (Smithlite) galvanised 10 gal boiler*
18. *Lamb, Hingley & Co.'s "Apex" model 436*
19. *F. J. Tomlinson "Handy" boiler*
20. *Vactric V.77 cabinet model*
21. *South Wales Switchgear model 353 wash boiler*
22. *Morley Products "Main 55 Plus" cabinet boiler*
23. *Universal Boilers round type boiler*

I.E.E. LONDON MEETINGS

FOLLOWING our customary practice, we set out below the list of meetings of the Institution of Electrical Engineers and of the various Sections which will be held during the second half of the 1956–57 session. The main social function is, of course, the annual dinner of the Institution, which will be held on 28th February at Grosvenor House, W.1. Section functions are the dinner-dance of the Supply Section (Criterion) on 5th March and the joint dinner-dance of the Radio and Measurement Sections (Café Royal) on 15th March.

This year's Faraday Lecture has already been given by Dr. T. E. Allibone at some of the provincial Centres; he will deliver it in London (at the Central Hall, Westminster), on 13th February. The title of his lecture is "Nuclear Energy in the Service of Man." The Kelvin Lecture will be given on 4th April* by Dr. G. B. B. M. Sutherland, whose subject will be "Infra-Red Radiation." A meeting of special interest is the ordinary meeting on 24th January when a symposium of papers on the "Transatlantic Telephone Cable" will be presented. This will be a joint meeting, linked by the cable, with the American Institute of Electrical Engineers and the Engineering Institute of Canada. The annual general meeting of the Institution will be held on 23rd May.

Visits arranged are the Radio and Telecommunication Section to the B.B.C. and I.T.A. television transmitting stations on 18th May, the Utilisation Section visit to Stratford-upon-Avon (31st May–2nd June), a visit to Leicester by the Measurement and Control Section (in June), the Supply Section visit to Belgium (5th–9th September) and a visit to Holland by the Radio and Telecommunication Section (18th–22nd September).

The Summer Meeting of the Institution will be held in the North-Western Centre from 1st–5th July. The Education Discussion Circle is arranging an exhibition of apparatus for teaching electrical engineering to be held on 28th June at the Northampton Polytechnic, St. John Street, E.C.1.

ORDINARY MEETINGS

24th January: Symposium of papers on the Transatlantic Telephone Cable—Joint meeting, linked by the Cable, with the American Institute of Electrical Engineers and the Engineering Institute of Canada. **13th February:** Faraday Lecture "Nuclear Energy in the Service of Man," by Dr. T. E. Allibone (at the Central Hall, Westminster). **7th March:** "Cathodic Protection," by L. B. Hobgen, K. A. Spencer and P. W. Heselgrave. **21st March:** "A Cyclotron for Medical Research," by J. W. Gallop, D. D. Vonberg, R. J. Post, W. B. Powell, J. Sharp and P. J. Waterton (Measurement and Control Section paper). **4th April:** Kelvin Lecture, "Infra-Red Radiation," by Dr. G. B. B. M. Sutherland. **25th April:** "138 kV Submarine Power Cable Interconnecting the Mainland of British Columbia to Vancouver Island," by Dr. T. Ingledow, R. M. Fairfield, E. L. Davey, K. S. Brazier and J. N. Gibson (Supply Section paper). **23rd May:** Annual general meeting followed by "General Applications of Digital Computers," by Dr. A. D. Booth.

INFORMAL MEETINGS

18th February: Discussion on "The Impact of Radioactive Isotopes on the Utilisation Field," opened by Dr. D. Taylor. **18th March:** Discussion on "What is Limiting the Application of Servo Mechanisms in the Electrical Industry?" opened by C. Ryder. **15th April:** Discussion on "The Future of Plastics in Power Cables," opened by C. C. Barnes.

EDUCATION DISCUSSION CIRCLE

6th February: Discussion on "The Place of Liberal Studies in Sandwich and other Technological Courses," opened by E. H. Horrocks. **11th March:** Discussion on "Simple Approaches to the Understanding of Commutation," opened by Prof. A. Tustin. **2nd April:** Discussion on "The Teaching of Electrical Installation Subjects," opened by R. W. G. Ward. **6th May:** Discussion on "The Co-ordination of Education and Practical Training in Sandwich Courses," opened by C. Grad and A. Draper. **28th June:** Exhibition of Apparatus for Teaching Electrical Engineering (Northampton Polytechnic, E.C.1).

RADIO AND TELECOMMUNICATION SECTION

23rd January: "Junction-Transistor Bootstrap Linear Sweep Circuits," by K. P. P. Nambier and Dr. A. R. Boothroyd, "Design Considerations for Junction-Transistor Oscillators for the Conversion of Power from Direct to Alternating Current," by F. Oakes, and "Minority-Carrier Storage in Semi-Conductor Diodes," by J. C. Henderson and Dr. J. R. Tillman. **4th February:** Informal evening on "The Importance of Research in Hearing and Seeing to the Future of Telecommunication Engineering," talk by Dr. E. C. Cherry. **20th February:** "The Stereosonic Recording and Reproducing System (A Two-Channel System for Domestic Tape Records)," by H. A. M. Clark, Dr. G. F. Dutton and P. B. Vanderlyn (Northampton Polytechnic, E.C.1). **4th March:** Informal evening on "Electronics in Administration—A Survey," talk by Dr. D. C. Espley. **20th March:** "Recent Developments in X-Ray and Electron Microscopy with some Applications to Radio and Electronics," by Dr. V. E. Cosslett and C. W. Oatley. **1st April:** Informal evening on "Colour Television," talks by L. C. Jesty and Dr. E. L. C. White. **10th April:** "The Remote and Automatic Control of Semi-Attended Broadcasting Transmitters," by R. T. B. Wynn and F. A. Peachey. **29th April:** Informal evening on "Radio in Air-Sea Rescue," talks by G. W. Hosie, D. Kerr and W. Kiryluk. **15th May:** "A Survey of Transistor Circuit Techniques." **18th May:** Visit to B.B.C. and I.T.A. television transmitting stations. **18th-22nd September:** Visit to Holland.

SUPPLY SECTION

27th February: "Mechanical Strength of Power Transformers in Service," by E. T. Norris. **5th March:** Section dinner-dance (at the Criterion). **27th March:** "Earth Electrode Systems for Large Electric Stations," by J. D. Humphries. **24th April:** Annual lecture. **22nd May:** "Voltage Performance of Series Capacitors in Transmission and Distribution Lines," by J. M. Magowan (to be read by L. L. Langton). **5th-9th September:** Visit to Belgium.

MEASUREMENT AND CONTROL SECTION

29th January: "An Experimental Study of High Permeability Nickel-Iron Alloys," by C. E. Richards, E. V. Walker and A. C. Lynch, "A Method for the Precise Measurement of Permittivity of Sheet Specimens" and "A Bridge Network for the Precise Measurement of Direct Capacitance," by A. C. Lynch, and "A Simple Transformer Bridge for the Measurement of Transistor Characteristics," by W. F. Lovering and D. B. Britten. **26th February:** Discussion on "The Analysis of Waveforms," opened by A. Cooper and D. A. Drew. **9th April:** "A Deep Electrolytic Tank for the Solution of 2- and 3-Dimensional Field Problems in Engineering," by E. R. Hartill, J. G. McQueen and P. N. Robson. **16th April:** Discussion on "The Measurement of Currents in High-Voltage Circuits without Orthodox Current Transformers," opened by M. Kaufmann and Dr. A. J. King. **7th May:** "Invention and Nature," by F. W. Meredith. **June:** Visit to Leicester.

UTILISATION SECTION

14th February: "Self-Compensated Alternators," by P. J. Bhatt, "The Metal Rectifier and its Importance to the Electrical Engineer," by D. Mangnall and "The Automatic Factory" by G. F. Stewart. **14th March:** "Electrical Equipment for Rectifier Loco-

* This is a revised date and supersedes the date (2nd May) given in the list of events in our issue of 28th December.

motives," by H. B. Calverley, E. A. Jarvis and E. Williams and "Circuit Calculations for Rectifier Locomotives and Motor Coaches," by T. E. Calverley and D. G. Taylor. **11th April:** "Development of Transportable Thermal-Storage Space Heaters," by E. Bates and "Electrical Floor Warming," by J. W. Moule and W. M. Stevenson. **9th May:** "The World's Copper Resources," by H. J. Miller. **31st May-2nd June:** Visit to Stratford-upon-Avon.

JOINT SECTION MEETINGS

Supply and Measurement Sections. **30th January:** "Power System Protection, with particular reference to the Application of Junction Transistors to Distant Relays," and "A Dual-Comparator Mho-Type Distance Relay Utilising Transistor," by C. Adamson and L. M. Wedepohl. Measurement and Radio Sections. **12th February:** "The Ultimate Performance of the Single-Trace High-Speed Oscillograph" and "The Design and Performance of a New Experimental Single Transient Oscillograph with very High Writing Speed," by M. E. Haine and M. W. Jervis. Measurement and Supply Sections. **12th March:** "An Analogue Computer for Nuclear Power Studies" and "The Application of Analogue Methods to Compute and Predict Xenon Poisoning in a High-Flux Nuclear Reactor," by G. J. R. MacLusky. (In conjunction with the British Nuclear Energy Conference.) Radio and Measurement Sections. **15th March:** Joint dinner-dance (at the Café Royal).

JOINT MEETINGS WITH OTHER INSTITUTIONS

7th February: Third Graham Clark Lecture on "The Place of Engineering in University Education," by Sir Ifor Evans (with the Institutions of Civil and of Mechanical Engineers). **25th February:** Discussion on the Report on Engineering Education in the Soviet Union (with the Institutions of Civil and of Mechanical Engineers, at the I.C.E. Great George Street, S.W.1). **20th May:** Discussion on the Report on the Development of Hydro-Electric Power in the Soviet Union (with the Institutions of Civil and of Mechanical Engineers at the I.C.E.).

NEXT WEEK'S EVENTS

Organisers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 221, Dorset House, Stamford Street, London, S.E.1, to ascertain that proposed dates for their functions do not clash with others already arranged

Monday, 21st January

BIRMINGHAM.—Grand Hotel, 6.15 p.m. Birmingham Electric Club. "Lighting Applications," by W. R. Stevens.

BRISTOL.—Engineering Laboratories, University Walk, 6 p.m. I.E.E. Western Supply Group. "An Introduction to Nuclear Power Generation," by D. F. Welch.

LONDON.—Savoy Place, W.C.2, 6.30 p.m. I.E.E. London Graduate & Student Section. "Television Film Recording," by E. J. Stocks.

NEWCASTLE-UPON-TYNE. — King's College, 6.15 p.m. I.E.E. North-Eastern Radio & Measurements Group. Informal evening on "Electronics and Automation, Some Industrial Applications," by Dr. H. A. Thomas.

Tuesday, 22nd January

CAMBRIDGE.—Cavendish Laboratory, Free School Lane, 8 p.m. I.E.E. Cambridge Radio & Telecommunication Group. Informal evening on "The Use of Transistors in Radio and Television"; talks by Dr. A. J. Biggs and E. Wolfendale.

DERBY.—E.M.E.B. Service Centre, 6.30 p.m. I.E.E. East Midland Centre. "Choice of Insulation and Surge Protection of Overhead Transmission Lines of 33 kV and Above," by A. Morris Thomas and D. F. Oakeshott.

LEEDS.—1, Whitehall Road, 6.30 p.m. I.E.E. North Midland Utilisation Group. "Germanium and Silicon Power Rectifiers," by T. H. Kinman, G. A. Carrick, R. G. Hibberd and A. J. Blundell.

Tuesday, 22nd January, to Friday, 1st February

LONDON.—Olympia. Packaging Exhibition and Convention.

Wednesday, 23rd January

BELFAST.—College of Technology, 7.30 p.m. Belfast Association of Engineers. Film evening.

HUDDERSFIELD.—Technical College, 7 p.m. Society of Instrument Technology, South Yorkshire Section. "Testing and Control Methods in the Textile Industry," by S. L. Anderson.

IPSWICH. — Electric House, 7.15 p.m. Ipswich & District Electrical Association. President's address, "Electricity Supply in the Soviet Union," by C. T. Melling.

LIVERPOOL.—The Temple, Dale Street, 6 p.m. I.E.E. Mersey & North Wales Centre. "The Electronic Control of Machine Tools," by N. Milne. (Joint meeting with the Liverpool Engineering Society.)

College of Building, Clarence Street, 6.30 p.m. Institution of Heating & Ventilating Engineers, Liverpool & District Branch. "School Heating Systems," by C. A. Reynard.

LLANDARCY.—At the Training Centre, National Oil Refineries, Ltd., 7 p.m. Society of Instrument Technology, South Wales Section. "Present and Future Trends in Electronic Instrumentation," by R. J. Redding.

LONDON.—Savoy Place, W.C.2, 5.30 p.m. I.E.E. Radio & Telecommunication Section. Papers on "Transistor Applications."

Waterloo Bridge House, S.E.1, 5 p.m. Institution of Post Office Electrical Engineers, London Centre. "The Utilisation, Review and Planning of a Large Junction Network," by J. B. F. Williams.

NORWICH.—Assembly House, 7.30 p.m. I.E.E. East Anglian Sub-Centre. "A Transatlantic Telephone Cable," by Dr. M. J. Kelly, Sir Gordon Radley, G. W. Gilman and R. J. Halsey.

NOTTINGHAM. — E.M.E.B. Showroom Theatre, Smithy Row, 7.30 p.m. A.S.E.E. Nottingham Branch. "The Nature of Plastics," by H. H. Lusty, with film.

PONDERS END.—I.E.E. London Graduate & Student Section. Visit to Edison Swan Electric Co., at 2 p.m.

Thursday, 24th January

CHELMSFORD. — Crompton's Social Hall, 7.30 p.m. Chelmsford Engineering Society. "The Computer Control of Machine Tools," by G. S. Kermack.

LIVERPOOL.—The Temple, Dale Street, 6 p.m. I.E.E. Mersey & North Wales Centre. "The Pressurised Water Reactor as a Source of Heat for Steam Power Plants," by Dr. J. M. Kay and F. J. Hutchinson. (Joint meeting with the North-Western Branch of the Institution of Mechanical Engineers.)

LONDON.—Savoy Place, W.C.2, 5.30 p.m. Institution of Electrical Engineers, ordinary meeting. Symposium of papers on "The Transatlantic Telephone Cable." (Joint meeting, linked by the cable, with the American Institute of Electrical Engineers and the Engineering Institute of Canada.)

College of Preceptors, Bloomsbury Square, 7 p.m. Incorporated Plant Engineers, London Branch. Film: "Construction of the Owen Falls Dam."

Friday, 25th January

BIRMINGHAM.—Regent House, St. Philip's Place, Colmore Row, 6 p.m. I.E.S. Birmingham Centre. "Lighting of Educational Institutes," by A. G. Sheppard Fiddler.

BRIGHTON.—Grand Hotel. E.I.B.A. Sussex Centre. Annual ball.

BRISTOL.—Grand Hotel. A.S.E.E. Bristol & West of England Branch. Annual dinner.

CARLISLE.—Technical College, 7 p.m. I.E.E. North-Eastern Centre. "Electrical Energy from the Wind," by E. W. Golding.

COVENTRY.—G.E.C. Ballroom, Copsewood. Coventry Electric Club. Annual ladies' night.

GLASGOW. — Georgic Restaurant, Union Street, 12.30 p.m. I.E.S. Glasgow Centre. Luncheon meeting.

39, Elmbank Gardens, 7.15 p.m. Society of Instrument Technology, Scottish Section. Presidential address, "The Contribution of the Society to Industrial Progress," by A. J. Young.

MANCHESTER. — Engineers' Club, Albert Square, 6.45 p.m. Manchester Association of Engineers. Discussion on "Smokeless Zones." (Joint meeting with the Institute of Petroleum, Northern Branch.)

NEWCASTLE-UPON-TYNE. — County Hotel, Neville Street. I.E.S. Newcastle Centre. Dinner-dance.

NORTHAMPTON. — Angel Hotel, Bridge Street. Northampton & District Electrical Association. Annual dinner and dance.

WEYMOUTH.—South Dorset Technical College, 6.30 p.m. I.E.E. Southern Centre. "Germanium and Silicon Power Rectifiers," by T. H. Kinman, G. A. Carrick, R. G. Hibberd and A. J. Blundell.

Saturday, 26th January

LONDON. — I.E.E. London Graduate & Student Section. Visit to Ilford Running Sheds, British Railways, at 10 a.m.

Hotpoint Lecture Service

The Hotpoint Electric Appliance Co., Ltd., announces a lecture service covering a series of illustrated lectures by its Technical Sales Promotion Department. No lecture charges or expenses are involved; inquiries should be sent to the company's technical sales promotion manager, Mr. G. A. Williams, at Peterborough. The lectures are: "The History of Electric Washing Machines," "Kitchen Planning," "Refrigeration in the Home," "Principles of Refrigeration" and "The Electric Cleaner and Small Appliances." The lecturer provides a projector and screen.

Financial Section

STOCKS and SHARES

THE buoyancy of Government stocks has again been the outstanding feature of Stock Exchange markets. After no more than a brief hesitation over the change in the Premiership, prices actively resumed their rise to the accompaniment of persistent talk about a coming reduction in Bank Rate. All the British Electricity stocks added a point or more to previous gains. Continued firmness of industrial shares was credited largely to the gilt-edged influence, and was aided by the subsidence of conjecture about a general election. Individually, the new Imperial Chemical Industries 5½ per cent convertible loan stock has been the stock of the week. The attractions of this twin-purpose investment produced a demand even more enthusiastic than had been anticipated. From the opening figure of about 4, the premium rose quickly to 7 points, at one time, on the price of 96 at which the stock is offered to the company's shareholders.

Further Gains

Crompton Parkinson have been marked up further to 15s during the week, and the new shares issued by C. A. Parsons and A. Reyrolle were in good demand: payment in full was due in each case by last Wednesday. Otherwise the group of "atomic power" shares has again been content mainly to consolidate earlier improvements. Elsewhere, Decca were bought in advance of the dividend declaration, the "A" shares being another 1s 3d to the good at 29s 6d. Electric & Musical Industries repeated the previous week's rise of 2s 6d, and Hoover also continued on the upgrade to 27s 9d. In the cable section the recovery in Johnson & Phillips made progress to the extent of half-a-crown; Scottish Cables and T.C. & M. were 1s better at 16s 9d and 26s respectively. Crabtree Electrical rose 1s 6d to 24s 6d, attention being called to the yield of over 8 per cent. Gains of 1s or more were recorded in Brook Motors, Southern Areas and Holophane.

English Electric

If the English Electric Company is as expeditious as in previous years with its announcement of the final dividend and annual profits statement, the figures for 1956 will be out by the middle of February and one of the first major events in the coming season of company results. A year ago the company maintained the distribution at a total of 12½ per cent, which came from earnings equivalent to about 36 per cent on the ordinary capital. For 1956 the interim payment was maintained at 4 per cent. Any change in this year's final distribution would come as a surprise to the market, in view of the continuously heavy demands which development expenditure is making upon the financial resources of the big electrical groups. English Electric were last in the new capital market in September, 1955, when

Price Changes in

Company or Board	Nom. Value	Middle price 14th Jan.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1956 Highest	1956 Lowest
Gilt-edged Stocks						£ s d		
Brit. Elec. 1968/73	100	77⅛	+2	3	3	3 17 6	80⅛	72⅛
Brit. Elec. 1974/77	100	75⅛	+1	3	3	3 19 6	79⅛	71⅛
Brit. Elec. 1976/79	100	79⅛	+1	3⅛	3⅛	4 8 0	84	74⅛
Brit. Elec. 1974/79	100	89⅛	+1	4⅛	4⅛	4 15 0	95	85⅛
Overseas Electric Supply								
Calcutta Elec.	£1	18/6		6†	6†	9 9 9†	20/9	18/6
East African Power	£1	20/-		7	7	7 0 0	21/3	19/-
Nigerian Elec.	£1	17/6		10	10*	11 8 6	21/-	17/-
Perak Hydro-Elec.	£1	14/-		10	10*	14 5 6	17/6	14/-
Equipment and Manufacturing								
Aberdare Cables	5/-	10/3		17½	17½	8 10 9	13/6	9/9
Aerialite	1/-	5/-		45	48	9 12 0	6/9	4/9
Allen, W. H.	£1	36/3		20	10*	5 10 3	39/-	33/6
Aron Elec. Ord.	£1	52/6		15	15	5 14 3	56/-	52/6
Assd. Automation	10/-	18/6		10	5	2 14 0	19/-	15/-
Assoc. Elec. Ord.	£1	66/3		14	15	4 10 6	85/6	57/6
Automatic Tel. & El.	£1	55/-	−1/3	15	15	5 9 0	72/6	50/-
Babcock & Wilcox	£1	72/6	−1/3	15	15	4 2 9	85/6	64/-
Baldwin, H. J.	2/-	4/6		20	20	8 17 9	5/-	3/9
Bakelite	10/-	21/3		16	16	7 10 6	34/-	21/3
Berry's Electric	5/-	5/9		—	10‡	8 14 0	6/6	5/9
British Aluminium	£1	67/6		12	12	3 11 0	78/9	40/6
B.I. Callender's	£1	50/9	+6d	10	12½	4 18 6	54/3	45/-
B.I. Callender's 6% Pref.	£1	21/3		6	6	5 13 0	22/6	20/3
British Tabulating	£1	42/6	−1/-	9	9	4 4 9	51/3	37/3
British Thermostat	5/-	26/3		20	25	4 15 3	31/9	24/6
British Vac. Cleaner	5/-	8/-		30	15*	9 7 6	8/9	6/-
Brook Motors	10/-	31/3	+1/3	25	25	8 0 0	44/-	30/-
Brush Group	5/-	4/6		10	10	11 2 3	7/9	4/6
Bulgin, A. F.	1/-	4/9		45	50	—	5/3	4/-
Burco Dean	5/-	8/9		22½	20	11 8 6	13/6	8/3
Chloride El. Storage "A"	£1	58/-		17½	17½	6 0 9	73/6	55/-
Clarke Chapman	£1	127/6		20	22½	3 10 6	127/6	89/6
Cole, E. K.	5/-	17/6	+3d	17½	17½	5 0 0	22/3	15/-
Cossor, A. C.	5/-	6/-		15	Nil	Nil	10/3	5/-
Crabtree	10/-	24/6	+1/6	20	20	8 3 3	29/3	23/-
Crompton Parkinson Ord.	5/-	15/-	+1/3	16	16	5 6 9	15/-	12/3
De La Rue	5/-	16/3	−3d	30	30	9 4 6	20/3	15/-
Decca "A"	4/-	29/6	+1/3*	56½	43¾*	5 18 9	44/9	23/3
Desoutter	5/-	28/-	−1/-	25	30	5 7 3	32/9	25/9
Dewhurst	2/-	6/9		30	16½*	4 16 3	7/6	5/3
Dictograph Tel.	2/-	7/-		20	20	5 14 3	7/3	5/6
Dubilier Condenser	1/-	5/9		25	30	5 4 3	5/9	3/6
Duport	5/-	17/9		23	25	7 0 9	21/6	13/9
E.M.I.	10/-	29/-	+2/6	15	15	5 3 6	37/-	22/6
Electrical Components	5/-	6/9	−3d	25	25	9 5 3*	8/-	6/3
Elec. Construction	£1	25/-	+1/3	8½	8½	6 16 0	29/9	22/6
Elliott Bros.	5/-	27/-		17½	20‡	3 14 0	36/9	22/6
Enfield Cable Ord.	£1	14/-		Nil	Nil	Nil	19/3	13/-
English Electric	£1	48/9		12½	12½	5 2 6	66/3	43/9
English Electric 3¾% Pref.	£1	13/-		3¾	3¾	5 15 6	14/6	12/6
Ericsson Tel.	5/-	34/6		20†	20†	2 18 0†	42/9	31/-
Ever Ready	5/-	28/9		35	35	6 1 9	32/9	24/-
Falk Stadelmann	£1	35/9		17½	17½	9 15 9	45/9	35/6
G.E.C. Ord.	£1	52/6		12½	14	5 6 9	65/6	41/3
G.E.C. 6½% Pref.	£1	22/-		6½	6½	5 18 3	23/9	21/3
General Cables	5/-	11/3		30	30	13 6 9	13/9	11/3
Greenwood & Batley	£1	46/3		17½	17½	7 11 3	47/6	45/-
Hackbridge Holdings	5/-	20/3	−6d	25	30	7 8 3	24/6	18/9
Hackbridge & Hewittic	5/-	13/9		30	23*	8 7 9	22/-	13/9
Heatrae	2/-	4/-		15	15	7 10 0	5/1	3/9
Henley's	10/-	16/3	+3d	10½	11½	7 1 6	19/9	14/-
Holophane	5/-	18/9	+1/3	30	30	8 0 0	21/6	17/-

The above quotations are based upon middle prices in the Stock Exchange Daily Official List.
* After scrip issue. † Free of income tax. ‡ Dividend indicated.

about £11 million was raised by an ordinary share issue.

H. J. Baldwin Meeting

Prospects for H. J. Baldwin & Co. were described as excellent by the chairman at the recent annual meeting. In the year under review, running to last March, profits (before tax) improved to over £79,000, reflecting an increase of some 15 per cent in group turnover, of which a fifth was for export. Much of the improvement was credited to the growth of subsidiaries engaged in railway and general engineering, and the chairman put emphasis on the extent to which the basis of the activities had been widened in the past few years. Dividends totalling 20 per cent have been paid for five years in succession, the last of them being covered by earnings equivalent to 37 per cent of the issued ordinary capital of £135,000. At 4s 6d, the 2s shares give a yield of 8·9 per cent.

Electrical Investments

Company or Board	Nom. Value	Middle price 14th Jan.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield%	1956 Highest	1956 Lowest
Equipment and Manufacturing—continued								
Hoover	5/-	27/9	+1/-	70	50	9 0 3	39/3	23/-
I.C.I.	£1	40/-	+6d	10	10	5 0 0	49/9	37/3
Intl. Combustion	5/-	20/-		25	20*	5 0 0	25/-	15/3
Johnson & Phillips	£1	32/6	+2/6	15	15	9 4 6	46/6	27/6
Lancashire Dynamo	£1	37/6		15	11*	5 17 0	49/9	37/6
Laurence, Scott	5/-	14/3		12½	15	5 5 3	16/9	13/3
Lister, R. A.	£1	27/6		9·3	10	7 5 6	35/3	24/6
London Elec. Wire	£1	43/6	+6d	12½	12½	5 15 0	52/9	42/6
Lucas, J.	£1	31/3	−9d	7½	7½	4 16 0	40/3	28/9
Marryat & Scott	2/-	8/3	−3d	30	30	7 5 6	11/3	8/9
Mather & Platt	£1	52/6	+1/-	15	15	5 14 3	65/3	50/-
Metal Industries	£1	21/-	−2/-	9	9	—	27/-	16/3
Midland Elec. Mfg.	£1	45/-		10	12½	5 11 0	48/6	43/6
Morphy-Richards	4/-	12/-		50	50	—	13/9	10/-
Murex	£1	66/3		20	20	6 0 9	74/6	60/-
Newman Ind.	2/-	2/3		10	10	8 17 9	2/9	2/1
Oldham & Son	1/-	2/6		20	17½*	7 0 0	3/-	2/3
Parnall (Yate)	5/-	6/3	+3d	14	12	9 12 0	9/6	5/6
Parsons, C. A.	£1	52/6		10	10	—	—	—
Plessey	10/-	62/-	+9d	27½	30	4 16 9	87/6	56/-
Pye "A" Deferred	5/-	17/-	+9d	12½	12½	3 13 6	21/3	13/3
Reyrolle	£1	92/6		15	16½	3 10 3	117/6	81/-
Rheostatic	4/-	9/-		18½	12‡	5 6 9	—	8/3
Richardsons Westgarth	5/-	17/-	−3d	16¾	16¾	4 18 0	17/3	13/9
Scottish Cables	4/-	16/9	+1/-	27½	27½	6 11 3	17/9	14/9
Smith (England), S.	4/-	13/6		17½	17½	5 3 9	14/3	10/6
Southern Areas	£1	16/3	+2/6	10	7½	9 4 6	28/9	13/9
Strand Elec.	5/-	7/9		15	15	9 13 6	8/6	6/9
Sturtevant	5/-	24/6	+6d	14·4†	15†	3 1 3†	31/3	21/3
Sun Elec.	£1	42/6		20	25	11 15 3	42/6	33/9
Switchgear & Cowans	5/-	13/9	+9d	20	25	9 1 9	17/-	12/9
Taylor Tunnicliff	5/-	11/9		15	15	6 7 9	14/-	11/3
T.C.C.	10/-	33/9		25	25	7 8 3	45/-	33/9
T.C. & M.	£1	26/-	+1/-	8½	8½	6 10 9	34/-	24/-
Telephone Mfg.	5/-	6/6		10	10*	7 13 9	8/6	6/-
Thorn Elec.	5/-	18/3	+9d	15	15	4 2 3	22/6	15/-
Thornycroft	£1	33/9		15	12½	7 8 3	49/9	33/6
Tube Investments	£1	58/9	−9d	22½	15*‡	5 2 3	70/6	50/9
Vactric	5/-	13/-		15	17½*	6 14 6	15/-	11/-
Veritys	5/-	9/3		12½	12½	6 15 3	10/-	6/9
Walsall Conduits	4/-	11/9		70	20*	6 16 3	13/6	10/9
Ward & Goldstone	5/-	37/-		30	35	4 14 6	39/6	29/-
Watford	2/-	6/3		25	25	8 0 0	7/6	5/6
Westinghouse	£1	75/-	+2/6	18	18	4 16 0	100/-	67/6
West, Allen	5/-	13/-	+6d	15	15	5 15 6	14/6	11/3
Wolf Electric	5/-	17/6		20	20	5 14 3	26/3	17/6
Trusts, Transport and Communications								
Anglo-Portuguese	£1	21/3		8	8	7 10 6	23/6	20/3
Brit. Elec. Traction: Def. Ord. "A"	5/-	17/6	−1/-	22½	22½	6 8 6	20/-	15/6
Cable & Wireless: Ord.	5/-	10/6	+6d	10	10	4 15 3	11/3	9/3
4% Loan	100	90½		4	4	4 8 6	92½	88
Calcutta Trams	£1	23/-		7½†	8½†	7 7 9†	27/6	23/-
Cape Elec. Trams	£1	15/6		8	8	10 6 6	20/3	15/6
Marconi Marine	£1	32/-	+6d	10	10	6 5 0	34/-	31/-
Oriental Tel. Ord.	1/-	72/6		16	—	—	90/-	66/3
Telephone Rentals	5/-	10/6	+3d	12½	12½	5 19 0	11/9	9/6

Telephone Issue

Telephone Rentals will be raising rather more than half-a-million new capital through the proposed issue of 1,400,000 5s ordinary shares at 7s 6d each. These are to be offered to existing shareholders on the 28th of this month in the proportion of one new for every five shares held, and will be entitled to the final dividend for 1956. In an accompanying statement, the chairman refers to tendencies for profit margins to contract but for business to continue its expansion. He expects that it will be possible to maintain this year's final dividend at 7½ per cent, and the total at 12½ per cent, as for last year. On the basis of the present quotation of 10s 6d for the 5s shares, rights to the new issue are worth 6d per share. Results for 1956 will be due to appear in May.

Westinghouse Results

Westinghouse Brake & Signal £1 shares have remained a firm market, at around 75s, since the declaration of the single annual dividend of 18 per cent and of the financial results for the year ended in September. The dividend is at the same rate as on the two previous occasions, but is payable this time on capital increased by a "rights" issue of 615,000 new shares. By this issue the company raised over £2 million, and another £1 million new money was produced earlier through a new loan stock. According to the preliminary statement, group profits (after depreciation) improved last year by some 30 per cent to £1·7 million and so appear to have more than recovered the setback of the previous twelve months. The yield on the shares is 4·8 per cent.

Loan Stocks

The market can offer a fair range of straightforward debenture and unsecured loan stocks paying about 5¾ per cent on the money. G.E.C. 6 per cent unsecured loan, redeemable 1976–81, is now fully paid up and stands at about 104, the yield being 5¾ per cent. Ever-Ready 5¾ per cent debenture 1976–81 pays a fraction less at 101, and is still available free of transfer stamp duty. The 5¾ per cent loan stocks of Telegraph Construction & Maintenance and of Johnson & Phillips have both been on offer lately at two points under par, and are redeemable finally in 1976.

REPORTS and DIVIDENDS

R. A. Lister & Co., Ltd.—The annual meeting was held on 11th January. In his circulated statement, Sir Percy Lister (chairman) said that the year under review once again established a record and for the first time the profits passed the £1 million mark. During the year the factories had been fully employed, and among interesting contracts awarded to the group of companies were a repeat order from the British Railways for Blackstone diesel engines for shunting locomotives, a contract for marine propulsion engines for oil tankers, and a substantial contract from Egypt for pumping units for rural water supply. In connection with the last mentioned contract, whilst current circumstances would not permit of any payment on account of any unshipped portion of the contract, any losses which might occur from abnormal influences on trade resulting from the "Suez Canal problem" would be small, and had so far as was possible been provided for in the accounts.

The expanding range of their new Lister air-cooled diesel engines and the Lister and Blackstone range of marine propulsion and marine auxiliary engines was attracting a growing demand in the home and export markets. The new multi-level loader and the smaller diesel-engined runabout truck introduced during the year had met with an encouraging demand, and the new products to be introduced during the current financial year would, he believed, meet with a like response.

The Westinghouse Brake & Signal Co., Ltd., reports group profits for the year to 29th September last of £1,733,122, as compared with £1,325,059 for the preceding year, and after providing £789,686 for taxation, there is a net balance of £763,679 (against £666,779), of which £503,758 (£494,838) is attributable to the parent company. General reserve receives £200,000 and the dividend for the year is unchanged at 18 per cent, but is paid on increased capital. The balance carried forward is £368,622 (against £340,799 brought in).

Telephone Rentals, Ltd., proposed to raise £528,000 by an issue of 1,408,000 5s ordinary shares at 7s 6d each. The new shares will be offered to ordinary shareholders on 28th January on a one-for-five basis. They will rank for the final dividend to be declared in respect of the year ended 31st December last. In his letter to shareholders, Mr. F. T. Jackson (chairman) says that profit margins tend to contract but, on the other hand, the business continues to expand, and the directors have every expectation that the dividend on the ordinary capital (as increased by the proposed issue) will be maintained at 12½ per cent per annum. The consent of the Capital Issues Committee has been received to the proposed issue. An extraordinary meeting will be held on 28th January to create 4,000,000 5s ordinary shares.

British Industrial Plastics, Ltd.—The accounts for the year ended 30th September last show group profits of £833,774, as compared with £872,916 for 1954-55. From this are deucted depreciation of £217,425 and taxation of £319,854, leaving a net balance of £296,495 (against £331,940). General reserve receives £300,000, and it is proposed to pay a final dividend of 12½ per cent, making 20 per cent for the year (unchanged). The balance carried forward is £256,126 (against £399,130 brought in).

J. H. Fenner & Co. (Holdings), Ltd.—The consolidated accounts for the year ended 31st August last show a trading profit of £517,203, as compared with £486,204 for 1954-55, and a net profit of £428,096 (against £407,914). It is proposed to pay an ordinary dividend for the year of 12½ per cent and to carry forward £180,654 (against £261,597 brought in).

New Companies

S. V. Burton (Electrical), Ltd.—Registered 1st January. Capital £1,000. Electrical engineers and contractors, etc. Directors: S. V. Burton and V. Andreanoff. Secretary: Marjorie G. Burton. Regd. office: 80, Bishopsgate, E.C.2.

K. H. Baynton & Son (Electrical Contractors), Ltd.—Registered 17th December. Capital £1,000. Directors: K. H. Baynton and Mrs. Mary E. Baynton. Regd. office: 155, Albany Road, Cardiff.

Kingsway Electrical Appliances, Ltd.—Registered 31st December. Capital £1,000. Manufacturers, sellers and servicers of and dealers in electrical and power driven appliances of all kinds, etc. Directors: E. G. Waters and M. H. Jones. Regd. office: 153b, High Street, Slough, Bucks.

Electronic Animations, Ltd.—Registered 1st January. Capital £500. Manufacturers of and dealers in electric and electronic timing devices and coin operated machines for display animation, etc. Directors: W. Pendlebury and C. J. Warwick. Regd. office: 62, Knowsley Street, Bolton.

Westson (Electrical Engineers), Ltd.—Registered 7th January. Capital £500. Directors: F. Westhead and Mrs. May Westhead. Regd. office: 11, John Street, Bolton.

Liquidations

Contemporary Arts (Frinton), Ltd., electrical contractors, and radio and television retailers.—Winding up voluntarily. Liquidator, Mr. N. W. Osborne, 11-12, Finsbury Square, London, E.C.2, appointed 28th December.

Gilbert Electrical Tool Services, Ltd.—Creditors' voluntary winding up. Meetings on 14th February at 15, Wellington Circus, Nottingham, to receive an account of the winding up by the liquidator, Mr. K. F. Pool.

C. Saunders & Co. (Electrical Contractors), Ltd.—Last day for receiving proofs for dividend 22nd January. Liquidator, Mr. R. F. Bendall, 126, Colmore Row, Birmingham, 3.

R. Russell (Electrical), Ltd.—Liquidator, Mr. B. Phillips, 76, New Cavendish Street, London, W.1, with a Committee of Inspection, appointed 14th December.

E. & A. Perkins (Gosport), Ltd., electrical engineers.—Winding up voluntarily. Liquidator, Mr. R. G. Nobbs, 70, Victoria Road North, Southsea, Hants, appointed 22nd December.

Bankruptcies

S. Whitton and **L. Whitton**, carrying on business in partnership at Church Place, Victoria Road, Leeds, under the style of F. Whitton & Sons, electrical engineers.—Trustee, Mr. W. H. Meredith, 29, East Parade, Leeds, 1, Official Receiver, released 21st December.

G. S. Lacey, 74, Saint Giles Street, Norwich, electrical engineer.—Last day for receiving proofs for dividend 19th January. Trustee, Mr. F. R. D. Walter, Castle Chambers, Opie Street, Norwich, Official Receiver.

G. Wilson, 28, Holmwood Drive, Leicester, and formerly carrying on business at 1, Abney Street, Leicester, electrical engineer.—First and final dividend of 2s 9 13/16d in the £, payable at the Official Receiver's office, 27, Regent Street, Park Row, Nottingham.

F. W. Mason, carrying on business under the style of F. W. Mason & Son, at 20, Shamrock Avenue, Ipswich, electrical contractor and radio and television engineer.—Receiving order made 2nd January on debtor's own petition. Public examination 14th March at the Shire Hall, St. Helens, Ipswich.

T. T. Routledge and **F. Routledge**, carrying on business together in partnership as Routledge Bros., at 22, Hutton Grove, North Finchley, N.12, building contractors and decorators and electrical engineers.—Public examination 26th February at Bankruptcy Buildings, Carey Street, London, W.C.2.

TRADE MARK APPLICATIONS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be made up to 9th February:—

KEMA. No. 738,876. Class 9. Electric transformers, switches, switchgear, radio and television apparatus, electric fuses, plugs, sockets, connectors, junction boxes and electricity meters.—Naamlooze Vennootschap tot Keuring van Electrotechnische Materialen, Arnhem, Netherlands. Address for service, c/o McKenna & Co., 12, Whitehall, London, S.W.1.

COSSOR HYDRAUDYNE. No. B755,228. Class 9. Electronic apparatus for displaying, measuring and recording pressure conditions in fluid flow systems, and parts.—A. C. Cossor, Ltd., Cossor House, Highbury Grove, London, N.5.

VOLTOHMYST. No. 758,119. Class 9. Testing and measuring apparatus and intruments all for use in connection with electronic apparatus.—Radio Corporation of America, New York, U.S.A. Address for service, c/o Stevens, Langner, Parry & Rollinson, 5 to 9, Quality Court, Chancery Lane, London, W.C.2.

FLUXETTER. No. 755,910. Class 9. Magnetic apparatus for use in the amplification of electric current.—Metropolitan-Vickers Electrical Co., Ltd., St. Paul's Corner, 1-3, St. Paul's Churchyard, London, E.C.4.

VESTA. No. 752,752. Class 11. Low temperature electric heating elements for use in the manufacture of electric blankets, of electric heating pads and of electrically heated clothing.—Thomas French & Sons, Ltd., Chester Road Mills, Chester Road, Manchester, 15.

NOVALUME. No. 756,952. NOVALUX. No. 756,953. Class 11. Electric lighting fittings.—J. A. Macharg and J. Macharg, trading as the Nova Sign Co., 2, Saville Place, Newcastle-upon-Tyne.

NEW ELECTRICAL EQUIPMENT

Heater Guards

Guards are now available for the 1½ kW "Nightstor" and 2¼ kW "Nightstor Major" thermal storage heaters from the GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, London, W.C.2. They are made from perforated sheet steel and finished bronze to match the heater. The fixing is by a simple clip-on arrangement, easily removed for cleaning purposes, and the guard is so designed as to make it impossible to place anything on the heater. Alternative fixing positions allow it to be used when the heater is against a wall or furniture, or free standing.

Apart from this top guard a wire guard surround is also available. This is for wall fixing and is designed primarily for schools or any situation in which the heater has to be completely enclosed. The price of the top guard (HO.6415) is £3 10s and the wire surround (HO.6410) £5 15s.

Adhesive Nameplates

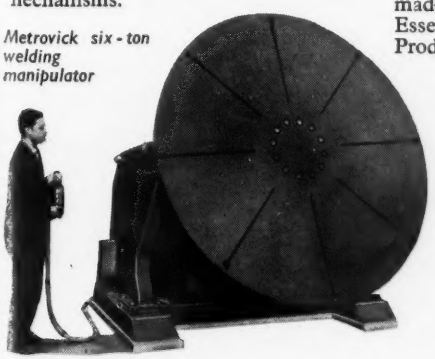
A wide range of self-adhesive nameplates for the engineering and electronic industries are now available from MILLETT, LEVENS (ENGRAVERS), LTD., Stirling Corner, Barnet By-Pass, Borehamwood, Herts. Chemically engraved brass, anodised printed and embossed aluminium, steel or plastic plates, can all be supplied. The plates are immersed for a few seconds in water, the surface film slides off, and, merely by firm thumb pressure, the plates hold permanently on to almost any kind of surface.

Welding Manipulator

A six-ton power operated manipulator is the latest addition to the range of welding equipment manufactured by METROPOLITAN-VICKERS ELECTRICAL CO., LTD., Trafford Park, Manchester, 17. The machine is of fabricated steel construction with the table designed for either constant or variable speed rotation and for tilting up to an angle of 135 deg. Both motions are imparted to the table through motor driven worm and wheel gearing with automatic braking and locking mechanisms.

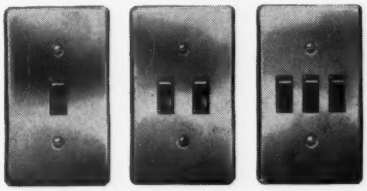
Two high torque squirrel cage motors are fitted on the machine with constant speed rotation. If variable speed is required, one of these is replaced by a variable speed motor with electronic control giving a speed range of 20 : 1. The design facilitates a quick conversion from one type of motor to the other. Motor control is effected from a remote push-button station complete with interconnections in a 20ft length of flexible conduit.

Metrovick six-ton welding manipulator



Small Switches

A new range of 5 A a.c. s.p. switches designed to fit 4 by 2in boxes has also been announced by M.K. ELECTRIC, LTD. One, two and three-gang patterns are available either with moulded insulated plates, in brown or ivory, or with solid brass plates finished BMA or matt chrome. The



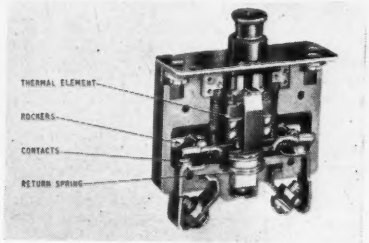
New M.K. Electric range of 1, 2 and 3-gang 5 A switches

switch-plates have slightly convex outlines giving an attractive modern appearance. The switch-units are mounted on zinc-plated steel grids and provision is made for alignment in cases where boxes are mounted out of square. Well-placed back entry terminals make for easy wiring. The respective prices of the switches per dozen are:—1-gang, 1-way, £1 5s (brown) and £1 6s (ivory); 1-gang, 2-way, £2 (brown) and £2 1s (ivory); 2-gang, 2-way, £3 6s (brown) and £3 8s (ivory); 3-gang, two 1-way and one 2-way, £3 8s (brown) and £3 10s (ivory).

Aircraft Circuit-Breaker

Improved protection against electrical overload in aircraft is provided by a new circuit-breaker now being made by the PLESSEY CO., LTD., Ilford, Essex, under licence from Mechanical Products, Inc., of Jackson, Michigan, U.S.A. This type "A" can withstand overloads of up to 6,000 A without suffering damage and the thermal release will break the circuit independently of the mechanical switch latches, even if the operating button is held in the "on" position.

Plessey aircraft circuit-breaker



A push-to-operate and pull-to-release button has been adopted and visual indication of the "on" and "off" positions is given by a white band round the button stem which is only visible in the "off" position.

Contact pressure is maintained by steel extension springs which do not carry current, connection between the contacts and the thermal element being effected by means of flexible conductors. To maintain low contact resistance and provide a self-cleaning wipe action, the contacts are mounted on rockers. The mechanical switch latches are of hardened steel to ensure long life. These circuit-breakers are available with current ratings from 5 to 50 A and comply with British and American military and aircraft specifications. Either or both of the terminals can be fitted with shrouds.

Industrial Vacuum Cleaner

The latest addition to the range of industrial vacuum cleaning plant manufactured by POWERVAC, LTD., 6, Cockhill, London, E.1, is the "Carryvac" model which can be carried on the back of the operator, or placed on its carriage according to the nature of the cleaning work to be performed. It is operated by a universal motor and control is by a push-bar switch in the connecting cable. It measures 22in high by 16in wide by 8in deep and the weight is 26 lb.

As a blower it is very suitable for the spreading of insecticides, fertilisers, etc., and can also be used with a spray gun. Accessories include 30ft of flex, wall brush, floor nozzle, angle piece, small brush, upholstery tool, crevice tool, and two extension tubes. The price of the complete unit is £51 9s.

"Carryvac" industrial vacuum cleaner

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (3s 0d each including postage) will be obtainable after 23rd January from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1951

17855. Standard Telephones & Cables, Ltd.—Control circuit for electric motors. 27th July, 1951. (766785.)

1952

8604. Gillott Electro Appliances, Ltd.—Electric convection heaters. 7th April, 1953. (766533.)

27976. British Thomson-Houston Co., Ltd.—Automatic operation of machine tools. 4th February, 1954. (766788.)

1953

6396. Telefunken Ges.—Arrangements for coupling helical wave retarders to high frequency lines or waveguides. 9th March, 1953. (766341.)

7320. Radio Receptor Co., Inc.—Rectifier. 17th March, 1953. (766634.)

8525. Standard Telephones & Cables, Ltd.—Travelling wave apparatus. 27th March, 1953. (766790.) 20596. Travelling wave tubes. 24th July, 1953. (466640.)

10987. Marconi's Wireless Telegraph Co., Ltd., and Buckingham, J.—Voltage stabilising circuit arrangements. 13th April, 1954. (766635.)

11312. Falkenthal, A., and Presser, H.—Photo-electric cells. 24th April, 1953. (766433.)

15834. Johnson, A. E., and Conway, T. D.—Electrical recording and reproducing apparatus. 3rd September, 1954. (766434.)

15936. Standard Telephones & Cables, Ltd.—Electron velocity modulation apparatus. 10th June, 1953. (766343.)

17938. Standard Telephones & Cables, Ltd.—Cathodes for electronic tubes and electronic tubes incorporating such cathodes. 29th June, 1953. (766794.)

22489. Standard Telephones & Cables, Ltd.—Electrical waveguide filters. 14th August, 1953. (766641.)

25603. General Electric Co., Ltd., Forbes, W. A., and Sumner, J.—Radio communication systems and apparatus therefor. 4th October, 1954. (766801.)

28669. Siemens Bros. & Co., Ltd.—Electric semi-conductor devices. 15th October, 1954. (766645.)

29412. British Insulated Callender's Cables, Ltd.—Manufacture of electric cables and insulated wires. 14th October, 1954. (766802.)

30505. General Electric Co., Ltd., Read, C. W. M., and Simpson, A. I. F.—Electrical apparatus of the kind including a thermionic valve. 4th November, 1954. (766648.)

33155. Imperial Chemical Industries, Ltd.—Electronic counters. 29th November, 1954. (Cognate application 10176, 7th April, 1954.) (766311.)

33242. General Railway Signal Co.—Electromagnetic relay counting systems. 30th November, 1953. (766441.)

33460. Allmanna Svenska Elektriska Aktiebolaget.—Method for the electrical insulation of the surface of metallic sheets for laminated magnetic cores. 2nd December, 1953. (766552.)

34162. Metropolitan-Vickers Electrical Co., Ltd.—Electrical time division multiplex information transmitting and receiving systems. 6th December, 1954. (766650.)

34291. Metropolitan-Vickers Electrical Co., Ltd.—Apparatus for producing high voltage d.c. from a.c. sources. 30th November, 1954. (765807.)

34922. Jackson Electric Stove Co., Ltd.—Electric cookers with grilling apparatus. 14th December, 1954. (766808.)

35321. Etablissements Merlin & Gerin Soc. Anon.—Arc extinguishing means for electric circuit-breakers. 18th December, 1953. (766655.)

35784. British Thomson-Houston Co., Ltd.—Radiation responsive apparatus. 20th December, 1954. (766556.)

1954

1328. Marconi's Wireless Telegraph Co., Ltd.—Continuously variable electric inductance devices. 4th November, 1954. (766559.)

1734. British Thomson-Houston Co., Ltd.—Signal recording or reproducing equipment operating in conjunction with a kinematograph or like projector. 19th April, 1955. (766349.)

3168. Electric & Musical Industries, Ltd.—Ultra-high-frequency oscillators. 28th January, 1955. (766663.)

4065. British Thomson-Houston Co., Ltd.—Circuit arrangements for dynamo-electric machines having rotating contact devices. 4th February, 1955. (766664.)

4966. Standard Telephones & Cables, Ltd.—Receiving circuit arrangement. 19th February, 1954. (766317.) 4968. Electrical intelligence storage arrangement. 19th February, 1954. (766318.)

5049. Automatic Telephone & Electric Co., Ltd.—Subscribers' line circuits for use in automatic telephone systems. 2nd February, 1955. (766563.)

7355. Marconi's Wireless Telegraph Co., Ltd.—Coaxial line structures. 25th January, 1955. (766448.)

8153. Reyrolle & Co., Ltd., A.—High voltage electrical switchgear. 17th June, 1955. (766450.)

8625. Metropolitan-Vickers Electrical Co., Ltd.—Saturable core reactance devices. 23rd March, 1955. (766669.)

9683. Wayne Kerr Laboratories, Ltd., and Calvert, R.—Electrical measuring bridges. 4th April, 1955. (766567.)

9763. Murphy Radio, Ltd.—Automatic gain control in television apparatus. 4th April, 1955. (766352.)

10949. Standard Telephones & Cables, Ltd.—Semi-conductor materials. 7th April, 1955. (766671.)

11205. Marconi's Wireless Telegraph Co., Ltd.—Thermionic valve amplifiers. 8th March, 1955. (766569.)

11410. Crosfield, Ltd., J. F.—Electrical multiplying circuits. 7th April, 1955. (766571.)

14829. Igranic Electric Co., Ltd.—Electric switch devices responsive to fluid pressure. 20th May, 1954. (766825.)

15321. Automatic Telephone & Electric Co., Ltd.—Checking circuits. 5th May, 1955. (766826.)

15806. Astral Switchgear, Ltd.—Electrical fuse-switches. 26th May, 1955. (766681.)

16256. Oldham & Son, Ltd., and Booth, F.—Separators for electric storage batteries made from paper pulp. 7th April, 1955. (766582.)

16857. Berglund, N. K. E.—Polarised electromagnetic devices. 8th June, 1954. (766687.)

17439. Kidde Co., Ltd., W.—Housing means for water-energised electric cells. 29th August, 1955. (766689.)

17480. Marconi's Wireless Telegraph Co., Ltd.—Electronic navigational aiding systems. 7th June, 1955. (766369.)

19224. Niftrik, J. W. J. Van, and Vries, A. de.—Arrangement for regulating the voltage-current characteristic of a.c. apparatus, particularly for stabilising the current and reducing the open-circuit voltage of welding transformers. 29th June, 1954. (766586.)

19246. Sylvania Electric Products, Inc.—Multiple density oxide coated cathodes and filament wire. 30th June, 1954. (766829.)

19350. Soc. Rateau, and Anxionnaz, R.—Turbines with a view to reducing the power absorbed by a rotor turning in the opposite sense to its normal direction of rotation. 1st July, 1954. (766469.)

19370. General Electric Co., Ltd., and Goodman, C. H. L.—Semi-conductors. 1st July, 1955. (766587.)

19492. British Thomson-Houston Co., Ltd.—Electric isolating switches. 4th July, 1955. (766699.)

19854. Parsons, Ltd., C. H., and Handley, G. B.—Lever-operated electric intermediate switches. 6th July, 1955. (766701.)

20071. Accumulatoren-Fabrik Akt.-Ges.—Negative electrodes for alkaline electric accumulators. 8th July, 1954. (766589.)

21811. Pilkington Bros., Ltd.—Glass electric insulator assembly units. 25th March, 1955. (766473.)

22624. Philips Electrical, Ltd.—Circuit arrangements for electric-gas discharge tubes. 12th July, 1955. (Addition to 612787.) (766711.)

23330. Mullard Radio Valve Co., Ltd.—Voltage stabilising circuits. 26th April, 1955. (766378.)

23641. Reyrolle & Co., Ltd., A.—High voltage circuit-breakers of the oil-break type. 15th August, 1955. (766592.)

24295. Igranic Electric Co., Ltd.—Solenoids. 20th August, 1954. (766716.)

24925. Thormann Engineering Co., Ltd., H. J., and Oliphant, J.—Electromagnetically operated counters. 19th August, 1955. (766479.)

24983. General Electric Co.—Magnetic cores for electrical apparatus. 27th August, 1954. (766595.)

27422. Siemens & Halske Akt.-Ges.—Electron tubes of the travelling wave tube type. 22nd September, 1954. (766724.)

27742. Automatic Telephone & Electric Co., Ltd.—Counting circuits. 25th September, 1954. (766843.)

28017. Kobler, V., and Kobler, W.—Connecting plugs for electrical apparatus. 28th September, 1954. (766844.)

28372. General Electric Co.—Devices for detecting radiation. 1st October, 1954. (766726.)

29471. Jackson Electric Stove Co., Ltd.—Cooker doors. 29th September, 1955. (766846.)

29767. Skillman & Co., Pty., Ltd., T. S.—Assembling of electrical components. 15th October, 1954. (766391.)

29781. Aktiebolaget Kanthal.—Electric resistors and alloys for use therein. 15th October, 1954. (766392.)

30252. Uher, E.—Moving coil relay for switching circuits with low energising electric currents, particularly for use in bridge circuits. 20th October, 1954. (766847.)

32076. Fenn, L. E.—Electric cigarette lighters. 5th November, 1954. (766606.)

34103. Piroux, J.—Fluid-tight electric accumulators. 24th November, 1954. (766398.)

35061. Philips Electrical Industries, Ltd.—Television systems. 3rd December, 1954. (766850.)

35843. General Railway Signal Co.—Code communication systems. 10th December, 1954. (766496.)

37696. Radio Corporation of America.—Semi-conductor signal receiving system. 30th December, 1954. (766744.)

1955

2080. Sangamo Weston, Ltd.—Moving iron electrical instruments. 24th January, 1955. (766753.)

2081. Spladis, Soc. pour l'Application d'Inventions Scientifiques.—Electro-medical appliances. 24th January, 1955. (766504.)

[*Concluded at foot of page* 133

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Australia.—General Post Office. 12th February. Uniselector maintenance parts. (E.S.B. 32585/56. Ten/23596.)*

Brazil.—State Electricity Commission. 28th February. Electricity meters. (E.S.B. 379/57. Ten/23623.)*

Burma.—Union Purchase Board. 24th January. Meters. (E.S.B. 998/57. Ten/23630.)*

Canada.—Saskatchewan Power Corporation. 11th February. Lightning arrestors. (E.S.B. 410/57. Ten/23643.)*

Coventry.—City Corporation. 31st January. Electric lamps and electrical equipment for the year ending 31st March, 1958. City engineer, Council House.

Crompton.—U.D.C. 2nd February. Electric lamps for the year ending 31st March, 1958. Surveyor, Town Hall, Shaw, near Oldham.

East Saltney (Flint).—Parish Council. 18th February. Street lighting equipment. (See this issue.)

Formosa.—Central Trust of China, Purchasing Department. 8th February. Two vacuum pumps and eight centrifugal pumps. (E.S.B. 664/57.I.C.A. Ten/23600.)* Three a.c. motors, three 150 and 200 kVA transformers, three 100 kVA auto-transformers, condensers and discharge reactors and two indoor switchboards. (E.S.B. 665/57.I.C.A. Ten/23601.)* 15th February. Steam raising plant including 40,000 lb/hr boiler. (E.S.B. 1095/57.I.C.A. Ten/23645.)*

India.—Government of Kerala. 22nd January. Four 500 kVA transformers. (E.S.B. 638/57. Ten/23592.)*

Director General of Supplies and Disposals. 29th January. 32 electric motor-driven pumping sets. (E.S.B. 901/57. Ten/23624.)*

Government of Mysore. 28th January. Circuit-breakers and current transformers. (E.S.B. 1001/57. Ten/23618.)*

India Store Department, London. 4th March. Five 2/200 kVA flameproof mining transformers. (See this issue.)

Uttar Pradesh Government. 31st January. 15,000 11 kV insulators. (E.S.B. 655/57. Ten/23627.)*

Government of Madras. 13th February. Coal and ash handling plant for Basin Bridge "A" station. (E.S.B. 32526/56. Ten/23524.)*

Iraq.—Ministry of Development. 25th February. 6·6, 11, 66 and 132 kV switchgear and associated equipment for substations. (E.S.B. 225/57. Ten/23547.)*

Directorate General of Municipalities. 16th March. Two 500 kW a.c. generating sets with switchboard. (E.S.B. 871/57. Ten/23612.)* 600 kW diesel alternator and 1,000 kVA transformer. (E.S.B. 364/57. Ten/23549.)* 250 kW generator with switchboard. (E.S.B. 362/57. Ten/23550.)* 23rd March. Two 150 kW a.c. generating sets. (E.S.B. 873/57. Ten/23614.)*

Korea.—Government Office of Supply. 13th February. 60 kW diesel generator set. (E.S.B. 469/57.I.C.A. Ten/23576.)*

Leeds.—Regional Hospital Board. 18th February. Reorganisation of electrical installation in Ward 4 at Castle Hill Sanatorium, Cottingham, and electrical installation in St. John's Hospital, Keighley. (See this issue.)

London.—Southwark Borough Council. 6th February. Electric lamps for one year. E. J. Pitt, town clerk, Town Hall, Walworth Road, S.E.17.

Newburn.—U.D.C. 4th February. Street lighting equipment. (See this issue.)

New Zealand.—General Post Office. 12th February. Instrument cords. (E.S.B. 212/57. Ten/23545.)* 13th February. Conduit for lead covered telephone cable. (E.S.B. 454/57. Ten/23580.)* 15th February. Composite coil and thermal operated relays. (E.S.B. 455/57. Ten/23595.)*

Dunedin City Corporation. 14th February. Interconnecting control cables. (E.S.B. 32559/56. Ten/23518.)* 22nd February. Two batteries for 6·6 kV, 250 MVA switchgear at substations. (E.S.B. 32557/56. Ten/23553.)*

Auckland Electric Power Board. 1st March. Insulated electric cable. (E.S.B. 230/57. Ten/23535.)*

State Hydro-Electric Department. 18th June. Four Francis reaction type water turbines, each of 56,000 b.h.p. (E.S.B. 283/57. Ten/23542.)* Four 40,000 kW generators. (E.S.B. 284/57. Ten/23543.)*

Northern Ireland.—Down County Education Committee. 31st January. Electrical installation in Downpatrick (New) Intermediate School. A. W. G. Holt, consulting engineer, 74, South Parade, Belfast.

Northern Ireland Housing Trust. 24th January. Electrical installations in 26 houses at Crossgar Road extension, Ballynahinch. Offices of the Trust, 12, Hope Street, Belfast.

Purley.—U.D.C. 28th January. Four fluorescent lighting fittings for Purley Library. (See this issue.)

Rhodesia and Nyasaland.—Federal Tender Board. 24th January. 200 electric fires and spares. (E.S.B. 330/57. Ten/23564.)*

Stoke-on-Trent.—City Corporation. 4th February. Electric lamps for the year ending 31st March, 1958. City surveyor, Town Hall.

Sutton Coldfield.—Borough Council. 12th February. Street lighting equipment. (See this issue.)

United States.—Garrison District Corps of Engineers, U.S. Army. 5th February. 42,105 kVA generator. (E.S.B. 32305/56. Ten/23552.)*

* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).

ORDERS PLACED

London.—L.C.C. Accepted. Renewal and improvement of electrical installation at Belleville County Primary School, Battersea (£3,833).—Beaufort Electrical Engineering Co., Ltd.

Peterborough.—Electrical work in 50 houses on the Crown Street estate (£1,079).—Peterborough General Electric Co.

South Shields.—Education Committee. Electrical wiring and fittings at Cleadon Park Open-Air Special School (£2,565).—Steels Engineering Installations.

Willesden.—Corporation. Recommended. Lighting installation, Edgware Road (£15,457).—G.E.C.

NEW PATENTS (*continued from page* 132)

2092. General Electric Co.—Electrolytic capacitors. 24th January, 1955. (766413.)

2669. Standard Telephones & Cables, Ltd.—Travelling wave electron discharge devices. 28th January, 1955. (766414.)

2841. Philips Electrical Industries, Ltd.—Switching circuits for selecting sources of voltage. 31st January, 1955. (766758.)

3323. Compagnie Electro-Mecanique.—Electromagnetic contactors. 4th February, 1955. (766415.)

3365. Standard Telephones & Cables, Ltd.—Light amolifying device. 4th February, 1955. (766416.)

4449. Mallory & Co., Inc., P. R.—Electromagnetic interrupter. 15th February, 1955. (766760.)

4593. Telefunken Ges.—Vapour cooling arrangements for electric-discharge tubes. 16th February, 1955. (766618.)

4946. Mijnssen & Co. N.V.—Single-phase a.c. fed driving arrangement for electric traction. 18th February, 1955. (766855.)

5114. International Business Machines Corporation.—Storage system using ferro-electric condenser. 21st February, 1955. (766514.)

5275/6. Zenith Radio Corporation.—Subscription colour television system. 22nd February, 1955. (766619/20.)

5408. Armour Research Foundation of Illinois Institute of Technology.—Magnetic transducer device. 23rd February, 1955. (766763.)

6177. Philips Electrical Industries, Ltd.—Magnetic electron lenses. 2nd March, 1955. (766857.)

6293. Singer Manufacturing Co.—Carbon pile contoller with built-in snap-action switch. 3rd March, 1955. (766767.)

6458. Philips Electrical Industries, Ltd.—Devices for vaporising substances by means of high frequency currents. 4th March, 1955. (766769.)

7945. Standard Telephones & Cables, Ltd.—Stranded conductors for electric cables. 18th March, 1955. (766862.)

9249. Westinghouse Electric International Co.—Electric control systems embodying transistors. 30th March, 1955. (766867.)

9250. Westinghouse Electric International Co.—Electrical invertor systems. 30th March, 1955. (766868.)

9370. Standard Telephones & Cables, Ltd.—Electric multiplex communication systems. 31st March, 1955. (766430.)

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors

Banbury.—Maternity wing at the General Hospital, Horton; Oxford Regional Hospital Board, 43, Banbury Road, Oxford.

Bardon Mill.—Pithead baths and canteen; N.C.B. Architects' Department, Whitley Road, Benton, Newcastle-on-Tyne.

Bath.—Girls' secondary modern school, Kelston Road; Snailum, Huggins & Le Fevre, architects, 18, Brock Street.

Blandford.—Showrooms, garage and workshops, Salisbury Road; D. W. Thomas, White Cliff, Mill Street.

Bradford.—Residential establishment on site adjoining Shirley Manor, Wyke (£46,150); W. Clifford Brown, city architect.

Bury.—Grammar technical school in Radcliffe Road; Bradshaw, Gass & Hope, architects, Silverwell Street, Bolton.

[*Continued on next page*

Cardiff.—Buildings for Department of Mining at the University; F. R. Bates & Son, architects, 70, High Street, Newport, Mon.

Carlton.—Houses (90), Phœnix Farm estate; E. C. Kirk, U.D.C. surveyor, Burton Road, Carlton, Nottingham.

Chelmsford.—Occupation centre (£21,000); Essex county architect, County Hall, Chelmsford.

Offices and modernisation of workshops; Page Optical Co., Ltd., Anchor Street Works.

Chertsey.—Houses (56), Free Prae Road; W. Deakin & Co., builders, rear 20, Guildford Road, Woking.

Chingford.—Houses (28), Kimberley Way; Hammond & Moxon, Ltd., builders, 87, Old Church Road, London, E.4.

Corby.—Shops and flats (18), Studfall Avenue; U.D.C. architect, Corby, Northants.

Crewe.—Departmental store in Market Street; Crewe Co-operative Friendly Society, Ltd., General Offices, Co-operative Street.

Dagenham.—Junior girls' school, The Warren (£53,000); H. Conolly, Essex county architect, County Hall, Chelmsford.

Dartford.—Factory and offices in Princes Road; Illinois Stoker & Combustion Co. of Great Britain, Ltd., 52, Grosvenor Gardens, London, S.W.1.

Derby.—Methodist church and hall, Littleover; Alfred Smith, builder, Empress Road, Derby.

Doncaster.—Flats (100), Parkway North, Wheatley Hills; borough architect.

Ebbw Vale.—Public hall as part of extensive civic building scheme; J. M. Davies, U.D.C. surveyor, Council Offices, The Walk.

Edgware.—Extensions; Boosey & Hawkes, Ltd., Sonorous Works, Deansbrook Road.

Edinburgh.—Factory at Bankhead, Sighthill; Weston Biscuit Co., Ltd., Slateford Road.

Elstree.—Houses (81), Brook Road extension; D. Howell, R.D.C. surveyor, Council Offices, Shenley Road, Boreham Wood, Herts.

Eston.—Central county modern school; North Riding county architect, County Hall, Northallerton.

Faversham.—Houses and flats (54), on Lower Road estate; borough surveyor, Municipal Offices.

Forfar.—Houses (30), Gallowshade; Scottish Special Housing Association, Ltd., 15-21, Palmerston Place, Edinburgh.

Gateshead.—Additions to stores, etc., in West Street for Gateshead Industrial Co-operative Society, Ltd. (£200,000); C.W.S. Architects' Department, 90, Westmorland Road, Newcastle-on-Tyne.

Houses (1,000) at Wardley, to be carried out in stages; George H. Gray & Partners, architects, 52, Camden Street, North Shields.

Glasgow.—Reconstruction of Victoria Infirmary; West Regional Hospital Board, West Regent Street, Glasgow.

Gosport.—Conversions at Thorngate Hall, and offices at rear, as additional accommodation for municipal offices; E. Addenbrooke, town clerk, Town Hall.

Harlow.—Research laboratories; Standard Telecommunication Laboratories, Ltd., Progress Way, Great Cambridge Road, Enfield.

Heanor.—New administrative block; I. & R. Morley, Ltd., Fletcher Gate, Nottingham.

Hereford.—Houses (114), Green Lane estate; Harry Vaughan, builder, 1, Cumbrae Avenue.

Herne Bay.—Flats (20), Pier Avenue; council surveyor.

Houghton-le-Spring.—Works additions for Norman Dawson, Ltd.; Fennell and Co., architects, Bridge End Chambers, Chester-le-Street.

Huddersfield.—First phase of new general hospital, for Leeds Regional Hospital Board; Pite, Son & Fairweather, architects, 6, Queen Anne's Gate, London, S.W.1.

Hull.—Houses (366), proposed on the Greatfield estate; A. Rankine, city architect.

Kidderminster.—Dwellings (225), Habberley estate; borough surveyor.

London.—Office block in Minories, City; Nightingale & Ambrose, architects, 27, John Adam Street, Strand, W.C.2.

Flats (36), Hall Park estate, Paddington; borough housing architect.

Showrooms and offices, 58/59, Trafalgar Square; Ford & Walton, Ltd., builders, Warton Road, E.15.

Five-storey building at 69-71, Newington Causeway, Southwark; S. Kelway Bamber, architect, 19, Percy Road, Leigh-on-Sea, Essex.

Factory in Domingo Street, Islington, for J. Hunnex & Sons, Ltd., 35, Parkhouse Street, S.E.5; Richard Ellis & Son, surveyors, 165, Fenchurch Street, E.C.3.

Five-storey block of flats, with lift, Darlington Row, Collingwood estate, Bethnal Green (£72,300); Architects' Department, County Hall, Westminster Bridge, S.E.1.

Lytham St. Annes.—Dawson art gallery in Kings Road; town clerk, Town Hall.

Manchester.—Nurses' training school, Oak Hill, Higher Broughton; Manchester Regional Hospital Board, Cheetwood Road.

Newburn.—Factory at Newburn Haughs for Anglo Great Lakes Corporation (£6,000,000); Sir R. McAlpine and Sons, Ltd., builders, Jesmond Road, Newcastle-on-Tyne.

Newcastle-upon-Tyne.—Secondary schools at Allendale, Ashington, Belford, Corbridge, Gosforth, Haltwhistle, Haydon Bridge, Longbenton, Newburn, North Sunderland, and Wallsend; county architect, County Hall, Newcastle-upon-Tyne.

North Shields.—Three-storey departmental stores on the Bedford Street/Russell Street corner site, for George Swan (North Shields), Ltd., 50, Bedford Street; Mauchlen Weightman & Elphick, architects, 12, Saville Row, Newcastle-on-Tyne.

Nuneaton.—New police headquarters and magistrates' court in Vicarage Street; borough architect.

Oxford.—Secondary modern school, Iffley Turn; Harrison & Cox, architects, 49, Frederick Road, Birmingham, 15.

Reigate.—Multi-storey flats, Dome estate; C. J. Pell & Partners, consulting engineers, 4, Manchester Square, London, W.1.

Rutherglen.—Houses (36), Cathcart Road; burgh surveyor, Town Hall Buildings.

St. Albans.—Flats (48), St. Peter's Street and Torrington Hill; city engineer.

Sheffield.—Radiotherapy centre (£140,000); Sheffield Regional Hospital Board, Fulwood House, Old Fulwood Road, Sheffield, 10.

Administrative block for Davy & United Engineering Co., Ltd., Darnall Works; Leslie & Co., Ltd., builders, Woodland Road, Darlington.

Sidcup.—Factory; Stoneham & Son (Deptford), Ltd., Empire Works, Watson Street, London, S.E.8.

Southend-on-Sea.—Administration block, canteen block, etc., for transport depot at Tunbridge Avenue (£75,000); borough architect, 30, Alexandra Street.

Swansea.—Pickle and mineral water factory, Carmarthen Road; Emanuel Thomas & Son, manufacturers, Niagara Works.

Wallsend.—Flats (132); borough surveyor.

Whittlesey.—Flats (16) and houses (94) in New Road; U.D.C. surveyor, Whittlesey, Cambs.

Woking.—Dwellings (42), Barnsbury Farm estate; U.D.C. surveyor.

Worthing.—Extension to Priory Old People's Home, Tarring (£36,000); Field Place Builders, Ltd., Peacock House, Goring Road, Goring-by-Sea.

Street Lighting Notes

ST. MARYLEBONE Borough Council is recommended to make application to the Minister of Transport and Civil Aviation for sanction to borrow £34,310 in respect of the first year's programme under the main road lighting replacement scheme.

BALLYMONEY (Northern Ireland) Urban Council has decided to proceed with a street lighting scheme costing £10,000.

PENRITH Highways Committee reports that a scheme for Group A electric street lighting of the trunk road A.66, from Victoria Road as far as Brooklands, has been approved by the Ministry and has been included in next year's grant programme.

BLACKBURN Corporation reports that the Ministry of Transport has approved the Council's proposals to improve the lighting of the main traffic routes at an estimated cost of £4,916. The Council is also to apply for permission to borrow £4,118 for the relighting of King Street and Preston Old Road.

The Ministry of Transport has asked the BLYTH Town Council to defer its £5,779 plan for the provision of sodium lighting in Newsham Road. The matter will be reconsidered when the Government's restrictions on expenditure are lifted.

FELLING (Co. Durham) U.D.C. is to spend £5,143 on the provision of sodium lighting in Shields Road, Pelaw.

MANGOTSFIELD U.D.C. is making application for sanction to borrow £20,000 for improved main road lighting.

COULSDON and PURLEY Council has been informed that the Ministry of Transport is prepared to consider contributing half the cost of bringing the lighting of the Brighton road up to Class "A" standard.

STIRLINGSHIRE County Council is applying for sanction to borrow £4,100 for the improvement of street lighting at Bonnybridge.

Improved lighting of a section of the trunk road at a cost of £31,000 has been approved in principle by COLWYN BAY Council.

SKEGNESS U.D.C. is recommended to approve a scheme for the conversion from gas to electricity of the street lighting in Burgh Road.

STOKE-ON-TRENT City Council is recommended to seek sanction to borrow £6,000 for the improvement of street lighting in Leek Road.

CHESTERFIELD Town Council plans to install sodium vapour discharge lighting along the A61 trunk road through the town at a cost of £9,700. The first part of the scheme is to cost £4,394.

EXMOUTH U.D.C. has placed a contract with the South Western Electricity Board for improved street lighting of the Exeter road at an estimated cost of £11,150.